Fire Research Note

No.953

THE BEHAVIOUR OF PEOPLE IN FIRES

by

P. G. WOOD

November 1972

A STUDY MADE UNDER CONTRACT AT
LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

FIRE
RESEARCH
STATION

F.R.Note No.953
November 1972

THE BEHAVIOUR OF PEOPLE IN FIRES

by

PETER. G. WOOD

SUMMARY

Under a contract from the Fire Research Station a study has been made of the behaviour of people in fires, using as a main data source a questionnaire administered by Fire Brigade Officers at the scenes of fires. A general analysis has been made of the things people did and more intensive studies have been made of two aspects, evacuation of the building and movement through smoke.

A summary of the main findings is given on pages 2-5.

KEY WORDS: Behaviour, building, fire, persons, smoke.

DEPARTMENT OF THE ENVIRONMENT AND FIRE OFFICES' COMMITTEE

JOINT FIRE RESEARCH ORGANIZATION

Behaviour of People in Fires

Joint Fire Research Organisation

Contract No. : AT/1170/08/FRS

Author :

Peter G. Wood

Research Fellow

Supervisors :

Professor A.B. Cherns

Professor W.F. Floyd

Loughborough University of Technology
Department of Social Sciences and Economics
Department of Ergonomics and Cybernetics

Acknowledgements

I wish to express my gratitude to the Chief Fire Officers and men of the following Fire Brigades for their co-operation and assistance during the large scale survey reported herein.

London Fire Brigade
Luton Fire Brigade
Glasgow Fire Brigade
Worcester Fire Brigade
Lancashire Fire Brigade
Essex Fire Brigade
Rochdale Fire Brigade
Liverpool Fire Brigade
East Sussex Fire Brigade
Leicestershire Fire Brigade

I am particularly indebted to Mr. Holland, Chief Fire Officer, West Riding Fire Brigade and Mr. Arnold, Chief Fire Officer of Warley Fire Brigade, both of whom retained an interest in, and allowed their Brigades to participate in all stages of the investigation.

I am also grateful to the staff of the Fire Research Station for their willing help at all times.

Finally I must thank my two supervisors, Professor Cherns and Professor Floyd for their support and encouragement.

Contents

THE BEHAVIOUR OF PEOPLE IN FIRES

1.0 Introduction

There can be little doubt that to an ordinary untrained person, involvement in a fire is an extremely stressful experience. Anecdotal evidence can be selected which suggests that behaviour in fires is anything from 'cool , calm and collected' to outright 'panic' behaviour, which is non-rational, non-social and non-adaptive. Since for any given person a fire would appear to be a 'rare' event, the majority of people never consider what actions they would take if they were involved in one.

Those concerned with the problems of Fire Prevention, Fire Protection and Fire Fighting must operate in the context of this general indifference, ignorance and variability of behaviour. The drawing up of legislation for fire protection, the design, planning and inspection of buildings for means of escape, the efficiency of fire prevention measures and the life saving activities of the Fire Service are all dependent, in the actual event, upon knowledge of the human behavioural responses which are made by the people involved in fires.

In this situation it is surprising to discover that there has been little attempt to systematically investigate the patterns of behaviour which people adopt when faced by a fire situation. The present research project was initiated in an attempt to supply some information on the above topic, in the belief that more effective techniques for the protection of people in fires can only be developed on the basis of such knowledge.

Although little work has been done on the study of behaviour in fires, a number of allied research areas would seem to overlap. For example there have been numerous field studies of natural disasters, mainly of a descriptive nature. Experimental work has been conducted on various aspects of psychological and physiological stress, and attempts have been made to simulate panic experimentally. In addition, anecdotal evidence from Fire Brigades and the results of a pilot study provided sufficient information to develop a priori hypotheses concerning key variables which might affect behaviour.

In attempting to study such a difficult problem, the selection of a suitable research technique is one of the main preoccupations of the early part of the investigation. Simulation of a fire situation was discarded as a possible method due to the ethical considerations implicit in such an experiment. The decision was therefore made to study fires which occurred during the course of the research. Both interview and questionnaire techniques were evaluated during the pilot phase of the research, a questionnaire administered by Fire Brigade officers at the scene of the fire being utilised for the main body of the study. By this method data was collected from nearly 1000 fire incidents, and more than 2000 people who were involved in them.

Behaviour itself was examined at two levels, a general analysis of the things which people did, and a more intensive study of two particular aspects, evacuation of the building and movement through smoke. These latter aspects were selected for study in view of their obvious importance in relation to the provision of means of escape in buildings. We thus have a general picture of overall behaviour in fires, and detailed knowledge of these two aspects. To construct a detailed model of behaviour in fires, future studies will be required to concentrate on other aspects, such as raising the alarm, contacting the Fire Brigade and fire-fighting behaviour. However, it was not, nor will it be, possible to conduct a single large study on all these factors using the present method of data collection. It would be unreasonable to expect Fire Service personnel to conduct extensive and lengthy interviews at the scene of the fire, when the utilisation of men and machines is at such a premium. This disadvantage was known and accepted before the main study was undertaken, it being considered that the advantages obtained from on-the-spot data collection far outweighed any restriction necessary on the volume of information collected.

1.1 Summary of Main Findings

As was indicated in the introduction, behaviour was examined both at a general level and with particular reference to two specific behavioural variables, evacuation of the building and movement through smoke. It is useful to continue this distinction in our summary of the main results.

General Behaviour

Over the course of the incident there are three general types of reaction to fire: they were, in order of frequency,

i) concern with evacuation of the building either by oneself or with others

ii) concern with fire-fighting or at least containing the fire

iii) concern with warning or alerting others, either individuals or the Fire Brigade.

The majority of behaviour falls either exclusively into one of these categories or some combination of them. The most frequent courses of action were in fact directed solely to one end, either leaving the building or fighting the fire.

In general terms the majority of people appeared to have behaved in what might be considered an appropriate fashion, although some 5% of the people did something which was judged to "increase the risk". There was little evidence of true 'panic'.

The actions taken were considered sequentially and the most frequent first actions were, in order,

i) Some fire-fighting action

ii) Contact Fire Brigade

iii) Investigate fire

iv) Warn others

v) Something to minimise the danger

vi) Evacuate oneself from the building

vii) Evacuate others from the building.

These seven classes of action describe almost 80% of the first actions taken.

Effect of other variables upon first action taken.

(1) The more serious a person considered a fire to be, the more likely that he would immediately leave the building and the less likely that he would attempt to fight the fire.

(2) Familiarity with the layout of building did not affect whether or not a person attempted to immediately leave the building. People who were less than completely familiar with the building were more likely to try and save personal effects.

(3) The more frequently people had received training or instruction on what to do in a fire, the more likely they were to raise the alarm or organise evacuation as a first action. In other respects frequency of training did not affect first action taken.

(4) People who had been previously involved in a fire incident were no more likely to contact the Fire Brigade than those who hadn't. They were, however, more likely to fight the fire or minimise the risk in some way. They were less likely to immediately leave the building.

(5) Women were more likely to take the following first actions :

(a) warn others

(b) immediately leave the building

(c) request assistance

(d) evacuate their family

They were less likely to take the following first actions :

(a) fight the fire

(b) minimise the risk

(6) An increasing proportion of people fought the fire from age 10 years to age 59 years.

EVACUATION OF THE BUILDING

(1) Men were less likely to leave the building than women. They were, moreover, more likely to return into the building if they did leave.

(2) People were more likely to leave the building if they didn't know any means of emergency escape.

(3) People were more likely to leave the building when smoke was present. They also returned in more frequently when smoke was present.

(4) People were less likely to leave the building if they had been previously involved in a fire incident. They were, moreover, more likely to return in.

(5) People who had never received training are more likely to leave the building. People who receive training at least once per month are less likely to leave.

(6) The time of occurrence of the incident did not affect whether or not people left the building.

(7) People were more likely to leave the building if the smoke spread beyond the room of origin. The greater the smoke density the more likely that people would leave the building.

(8) Differences in people's familiarity with the layout of the building did not affect which exit they used. The more familiar people were with the building, the more frequently they returned in.

(9) The more extensive the smoke spread, the more frequently exits other than normal were used.

(10) People returned into the building more frequently when members of their immediate family were present.

MOVEMENT THROUGH SMOKE

(1) In incidents where smoke was present, 60% of the people attempted to move through it. Nearly 50% of these people moved 10 yards or more.

(2) Men were more likely to move through smoke than women. They were also more likely to move greater distances.

(3) Knowledge of a means of escape did not affect whether or not a person moved through smoke. However, people who stated they did know a means of escape were more likely to move more than 15 yards through smoke.

(4) Previous involvement in a fire incident did not affect whether or not people moved through smoke. However, people who had been previously involved tended to move greater distances.

(5) The more familiar a person was with the layout of the building, the more likely that he would attempt to move through smoke. Familiarity did not however affect how far a person moved.

(6) The frequency with which a person had received training or instruction on what to do in a fire did not affect whether or not he would attempt to move through smoke. People who had never received training were less likely to move as great a distance through smoke as those who had.

(7) People were more likely to attempt to move through smoke if the incident occurred during the day than if it occurred at night. People involved in night-time incidents were however more likely to move further through smoke.

1.2 Summary of Other Findings

We have included in this section results which fall outside the mainstream of our interest at this time, but which nonetheless provide some insight into behaviour, or variables which affect it. The allocation of findings into 'major' and 'other' categories is in a sense somewhat arbitrary, since such a ranking depends so heavily upon the person's interests, training, background and personal theories.

(1) Where a recognised means of escape is provided, a significantly greater proportion of people said they knew of an escape route. However, 75% of the people who said they knew an escape route, did so where no recognised means of escape was present. Where recognised means of escape was present, 17% professed ignorance of any escape route. People who have been previously involved in a fire incident were more likely to know of an escape route than those who had not.

(2) A significantly greater proportion of people rated the fire as 'extremely serious' in the home environment, compared to other occupancies, where the fire was more likely to be rated 'not at all serious'. It was also more frequently rated 'not at all serious' if the fire started on a floor above the person, rather than the same floor or below. As both smoke density and extent of smoke spread increases, so did the proportion of people who rated the fire as 'extremely serious'. Age did not appear to be correlated with a person's rating of the seriousness of a fire.

(3) The correlation between the distance a person was prepared to move through smoke and the distance he could see ahead was imperfect. In some conditions people were prepared to move much further through smoke than their range of visibility. The distance moved through smoke was not related to the age of the person.

(4) Whether or not a person left the building was not related to whether or not he moved through smoke.

(5) The proportion of people who had been previously involved in a fire increased with increasing age up to the age range 50 to 59. In this modal category, 45% of the people claimed to have been previously involved.

(6) Men more frequently became first aware of the fire by :

(a) Seeing flames

(b) Hearing shouts

(c) Hearing a fire alarm.

Women more frequently became first aware of the fire by :

(a) Seeing or smelling smoke

(b) Being told

2.0 Theoretical Considerations

A study of the behaviour of people in fires falls under the general heading of 'Stress Research'. Now in the elegant world of physics, 'stress' has only one definition, Force per Unit Area, and the Units in which it is measured, Dynes per sq. cm., are not open to question. If we apply a known force to a known area of material, we can predict the amount of the resulting deformation or 'stress'. Unfortunately we do not have a "Young's Modulus" for people, and such simple relationships do not yet prevail in the Behavioural Sciences. Not only is there an enormous number of stimuli which might be considered 'stressors', but there is an equally large number of reactions whose nature might be considered "stress responses". Except in the case of extreme, life-threatening stimuli, the stressor is only defined as such in terms of the individual's response to it. In other words, we often do not know to what degree an individual will find a stimulus stressful, we only infer that it will be so, and attempt to confirm this inference by observing some behavioural or physiological reaction.

If we pursue the mechanical analogy for a short time, we may consider the case where we apply the same stress to two similar pieces of material. If we obtained different patterns of strain we might postulate two hypotheses. Firstly that the materials were in fact different substances, and secondly that the stress had not been applied in the same way to both samples. In a similar case, if we obtained different stress reactions to the same stimulus from two human individuals we might ask, "are these individual reactions a result of individual susceptibility to stress?, or due to individual perception of the degree of stress?" The problem of perception arises because human stress reactions are dependent upon a characteristic which is not apparent in the mechanical world, in that they can be elicited by the threat of a stressor. We will not obtain a strain in a material by merely warning it that we are going to apply a stress, the force must actually be applied. This concept of Perceived Threat is central to a consideration of human stress behaviour. Upon the type and duration of the Perceived Threat will largely depend the subsequent stress responses. If the stressor is very specific and the duration of Perceived Threat very short, then individuals may exhibit a fairly well defined range of stress reactions. If, however, the stimulus is more general and the period of Perceived Threat longer, as might well be the case in a Fire Situation, then we would expect the individuals to demonstrate a wider repertoire of responses, although they may contain some common elements. The aim of this research is to describe this repertoire and identify, if possible, the common elements.

Following from this one might hope to isolate elements of the situation which affect the behavioural reactions. In analysing the behaviour of people in fires, it is useful to consider the variables which may determine this behaviour under four general headings, ... the type of Threat imposed by this particular stressor, ... the type of person and how he deals with this

threat, ... the type of group to which he belongs, ... and the type of enviroment he is in, in this case, the type of building, and its architectural features.

2.1 Type of Threat

The Perceived Threat can be thought of as having a number of components which may influence the stress responses.

2.1.1 Firstly, the Probability of Occurence.

The more probable the individual perceives the threatened stress to be, the more strenuous will be his attempts to avert it. As the probability of the threatened event increases, then the individual will be prepared to exert greater effort in his adaptive responses. In the case of a fire situation, the initial discovery of the fire will involve the perception of some 'cues' that there is a fire, the smell of smoke perhaps, or the sound of burning. The question which is posed by these cues is .... "What is the probability that there is a fire?" If the cue is ambiguous and the threat perceived to be of low probability, then it will involve consideration by the individual of the "expense" or effort involved in his behavioural reaction. This is clearly one of the reasons for the apathy which is shown towards fire drills. The probability of there being a fire is perceived as very low, contrasted with the perception of the high 'cost' of such action in terms of time, inconvenience, effort.

2.1.2 The Nature of the Threat.

The second component is the Nature of the Threat in terms of its severity. This is clearly related, in terms of fire, to the previous experience of the individual. The great majority of the population will have had no training, or experience in recognising the cues leading to correct evaluation of the nature of the threat. Even if this were not so, the initial stages of a fire often produce cues which are ambiguous in nature. Often, only the appearance of flames seems to dispel any doubt as to the nature of the threat. It seems likely that the consideration of the severity of the threat is assessed by the individual in extremely personal terms. Thus the question is not only .... "If there is a fire how severe is it?" .... but also "To what degree does it threaten me personally?" Clearly the most severe threat is considered to be threat to one's life, or the lives of one's family. It has been suggested that this ultimate threat is the determining variable in the production of a "Panic" type response. I will discuss the concept of panic in some detail later.

2.1.3 The Imminence of the Threat.

The third component of Perceived Threat is concerned with the time factor, the imminence of the threat. The question this time is .... "How soon will it threaten me?" The closer

in time the threat is perceived to be, the more likely that the stress response will be non-adaptive, or non-rational. From published accounts it would seem that the rapid appearance and spread of fire is more likely to initiate a 'panic' type response.

2.1.4 Dealing with the Threat.

The fourth component is the possibility of Adaptation to the Threat. In this context, adaptation means, consideration of the power of the available actions to prevent harm. The most obvious is the possibility of escape. The urge to escape is primitive, and is likely to occur very early in severe stress. However, adaptation may take place on several levels and may, in the case of fire, involve such learned behaviour as attempting to extinguish the fire or contacting the Fire Brigade. In some cases of prolonged stress, such as a mine disaster in which men are trapped underground, it has been observed that the initial response is strenuous exploration of all the possibilities of escape. This often continues long after there is any 'objective' possibility of escape. When eventually escape is perceived by the trapped man as impossible, the adaptive response becomes one of conserving the organism, or less frequently, withdrawal. (Lucas, 1969) Let us now consider the individual and how he deals with the particular stress of fire.

2.2 Individual Reactions

The first process which is undergone by the individual is one of threat appraisal.

2.2.1 Threat appraisal means that he must detect the cues present, and recognise them as threatening. Due to the ambiguous nature of the cues in a fire situation, this often may not occur immediately. In addition, there frequently seems to be a predisposition to regard such initial cues optimistically. This would seem to be closely related to a conception noted in other hazardous situations which may be summed up by the aphorism .... "It can't happen to me'." This well-known factor has been reported widely in other fields of accident research and categorised as .... "The Personal Invulnerability Factor" It has been suggested that this is a threat-reducing procedure, operating on a 'denial' principle, which although giving a suitable name to it hardly serves to explain the phenomenon.

This indentification of cues as threatening is of course a dynamic process. The initial cues may be so diffuse as to alert the individual that there is something wrong, without being able to specify exactly what it is. This uncertainty leads him to attempt to verify the nature of the cues.

2.2.2 Attempts to Validate the Cues.

If the individual is alone he may make some attempt to discover the source of the fire cues, where the smoke or smell of burning originate. If, however, he is a member of a group

then his first attempts at evaluating the threat are likely to be to seek the opinions of other group members as to their assessment of the threat. Since in an untrained group the judgement of one member is unlikely to be better than any other, this process is unlikely to arrive at a true assessment of the threat. After the famous Orson Welles 'Invasion from Mars' broadcast in America, (Cantrill, 1947) one of the most striking differences between those who exhibited rational and non-rational behaviour, was in their ability to check the validity of the threat cues. Individuals who showed non-rational behaviour tended to base their judgements on very vague cues. For instance an individual looking out of the window and seeing traffic in the street would interpret it as .... "everyone's fleeing". Seeing a traffic-free street he would interpret it as .... "everyone's fled".

2.2.3 Definition of the situation.

Having appraised and attempted to validate the threat cues, the individual will then attempt to structure the situation, not only in terms of the elements of the perceived threat but also of his own personality, his previous training and experience. As mentioned earlier, fire cues are often ambiguous in nature, and as most people have little or no experience with the threat of fire, attempts to structure the situation may be frustrated. In some cases this inability to structure the situation may well start a vicious circle which serves to increase the level of threat. It is clear to the individual that some response is required; but because he cannot define the situation, he cannot initiate any behavioural reaction. This lack of action in a situation which clearly requires it, further increases the level of threat, which makes it even more difficult to structure the situation, ... "Frozen with fear" would seem to describe this state.

2.2.3 Evaluation of Responses.

Concomitant with the structuring of the situation must go a decision-making activity, concerned with the evaluation of available responses. The probabilities of certain courses of action having certain consequences must be estimated. Dependent upon this process will be the choice of action by the individual, to reduce the threat to himself. In a fire, these decisions may result in responses which can be interpreted as of the "flight or fight" type. Both escape from the immediate vicinity of the fire, and attempts to extinguish it will result in threat reduction for the individual. Calling for assistance, either from the Fire Brigade or elsewhere, would normally involve some retreat from the immediate area of fire, with the added threat-reducing possibility of passing on responsibility for taking appropriate action. The success of such threat-reducing response is not necessarily related to the objective level of threat, which may well be increasing. These initial actions may only afford a temporary respite in the level of threat, for instance, if the individual has chosen to "fight" the fire, then as long as it continues to be reduced or contained, he will experience a reduction in threat level. However, if he

perceives the fire to be 'gaining' on him then he will have to reassess his course of action to compensate for the increased 'perceived threat'. Similarly, in the case of 'flight' behaviour, if the initial response is successful, i.e. the individual escapes from the environs of the fire, and leaves the building completely, he may then experience an immediate and drastic reduction in the level of threat. This is a particularly dangerous situation, for if he now reassesses his responses, in the absence of any threat cues, he may consider that he over-reacted to the fire-threat, in-so-far-as it threatened his life, and the Perceived Threat may be transferred to belongings or property, with the result that he may re-enter the building, perhaps to be overcome by the fire. This type of behaviour is not untypical, and indeed there was a tragic illustration of it in a recent factory fire in Leicestershire.

If the initial behavioural response does not succeed in lowering the level of threat then, as in the case of inability to structure the situation, the stress on the individual will increase due to his failure to adapt. Greater effort will be invested in the adaptation responses, and as each is exhausted so will the choice of further action become less selective. It is in this situation, where the responses become more 'primitive', that rational behaviour may deteriorate into non-rational, and adaptive responses become non-adaptive, in other words what is often described as 'Panic response'.

2.3 Type of Group

Under this heading we could list several factors which can be identified as being of importance. Those which spring to mind are, the social structure of the group, the reaction of other group members, the number of people within the group and their training. Several of these factors have been subject to experiment in stress research and it is convenient to defer discussion of this variable to section 3.0. We will thus move immediately into consideration of our fourth variable.

2.4 Type of Environment or Building

In essence we would expect most of the architectural characteristics of a building to have some effect on behaviour. However what really concerns us, is how these characteristics are assessed in terms of their use as escape routes in fire. Widths of stairs, doors, exits, passageways, height of building, window height, are all physical constraints which will affect how the escape is implemented. In addition, the familiarity of occupants with the building layout, their concentration within the building, and their location when fire occurs are further important variables. Unfortunately, little research has been done on the circulation of people within buildings, although from published accounts of fire incidents it would seem that the physical size of circulation spaces and exits have not proved critical. What is more important is their location

in relation to the fire, and, in places where occupants are likely to be unfamiliar with the building, the location of signs directing them to exits. With regard to exit signs, there again seems to be little published research on their effectiveness.

Evidence concerning the utilisation of escape-routes is difficult to assess, mainly due to the heavy "weighting" in terms of publicity which is accorded to instances where escape routes are not used. There appears to have been a number of occasions when fatalities have occurred in buildings in which exits were both adequately provided and signposted. It is difficult to account for these examples without assuming that a massively incorrect assessment of the risk involved in using the escape-route has been made by the individual, leading to some non-adaptive, non-rational response. Because so little work has been done concerning the effects of the physical characteristics of the building, in relation to the behaviour of occupants, it is difficult to identify the key variables. However, some factors which might intuitively be thought to be critical, for instance, familiarity with the building, may not in fact be so. The chance of death in a hotel fire, for example, would seem to be little different from that in a dwelling. Obviously the difference in type of building might swamp any other factors, but in this case at least it would seem that unfamiliarity with the building cannot be separated as a major variable.

3.0 Previous Work of Immediate Relevance

There is a large body of literature which deals with the behaviour of people in real-life stress situations. Unfortunately it is almost entirely composed of anecdotal accounts of "panic" incidents or subsequent speculative analyses of why they occurred. There have been very few attempts at experimental investigation of the nature of such behaviour and for this reason it is worth examining them in some detail.

The first laboratory investigation of 'panic' behaviour was performed in 1951. (Mintz, 1951). In this experiment a number of cones with strings attached were inserted into a narrow-necked bottle. Subjects had to pull the cones out of the bottle under a number of conditions involving a nominal fine and reward system for success and failure. Only one cone could be taken out at a time or the neck of the bottle became jammed. Thus subjects had to cooperate with each other to stand any chance of success. It was hypothesised that 'panic' occurred due to the 'reward' structure of the system. If cooperative behaviour is once perceived as non-rewarding, by an individual 'at the back of the queue', then non-adaptive, competitive behaviour will occur, as it is perceived as the least-disadvantageous response. You will note that on this hypothesis, violent emotional excitement, or fear, is not considered to be variable in determining panic behaviour. The results of the experiment supported the hypothesis, in that under the reward/fine conditions, there was significantly more non-adaptive behaviour, than in the control conditions with no incentives. This experiment has subsequently been replicated with less clear-cut results, and in the light of our knowledge of threat, it would not seem to provide a meaningful analogue of a naturalistic panic situation.

The most interesting attempt to study panic behaviour has been made by Schultz in 1966. (Schultz, 1966). He starts by offering a definition of the term 'panic' making the point that the word has been and is, often misused in describing the behaviour of people fleeing from danger. In many cases, this flight is the only rational way in which to respond, the critical difference between rational escape behaviour and non-rational, panic, behaviour being in the manner in which we try to effect escape. He defines panic as .... "A fear-induced flight behaviour which is non-rational, non-adaptive, and non-social, which serves to reduce the escape possibilities of the group as a whole". This is a very useful definition although one might quibble with the rather general term, 'fear-induced', and also with the assumption that panic is always a group-oriented behaviour. In our earlier consideration of threat, we considered how an individual might reach a situation where his behavioural responses became non-adaptive due to his inability to control the level of threat. So we can conceive of an individual panicking alone, as well as in a group.

In an extensive series of studies, Schultz investigated a number of variables concerned with panic. An experimental situation was used which he considered to approximate conceptually to a theatre fire, in which all the people try to escape through a narrow exit. Subjects were placed in a danger situation, and faced with a threatened electric shock three times stronger than a sample shock of 50 volts actually given, if escape did not take place within a specified time period.

Escape occurred by operating a lever on the subject panel for two seconds. However, only one subject could operate the escape lever at a time. The instructions indicated that if more than one did so, the escape mechanism would jam and no one could escape.

The situation was so constructed that each subject received information that other members of the group were jamming the escape route in their own attempts to escape. Thus, the subject perceived that the escape route was blocked, at least temporarily. The subject had no way of knowing when the escape route would become unjammed; all the subject knew was whether the escape route was open or closed at the moment.

An alternative method of escape was available to the subject by pressing an emergency button at any time. This released the subject immediately but closed the regular escape route permanently, preventing the escape of the others and assuring their exposure to the electric shock. The pressing of this emergency button was considered to represent behaviour that is non-adaptive from the standpoint of the other group members, in that it prevented their escape. The pressing of the button, then, sacrificed the other members of the group but enabled the subject to escape.

Hence, pressing the emergency button in the laboratory and moving out of turn in the theatre fire were considered to be analogous behaviours. From the standpoint of total group survival these behaviours are non-social and non-adaptive. Both involve attempts on the part of the individual to save himself at the expense of all others concerned.

The variables investigated included the effect of: group size, perceived rate of escape of other group members, knowledge of escape time remaining, reduced subject anonymity, and perceiving that other group members had panicked. None of these produced significant differences in the incidence of panic. Several variables, however, produced non-significant trends in the direction of increasing the panic response. These were: increasing the level of threatened penalty for failure to escape, increasing the degree of subject anonymity, and introducing intense visual and auditory stimulation. Using the Cattell 16-PF Test it was found that panic responders were significantly more sensitive, effeminate, dependent, hypochondriacal and anxious than those who did not exhibit the panic response. A second series of experiments in

1967 (Schultz 1968) used similar apparatus, but altered the experimental situation slightly, in that, instead of being separated in the cubicles, subjects entered the laboratory in groups of five and were seated in a row separated by partitions. The incidence of the 'panic' response was investigated as a function of group composition and personality variables. No significant differences in panic response were found between: male versus female groups, females from two different subject populations, mixed sex versus single sex groups. Further, there was no significant difference in responses between a group of Naval reservists and a group of male college students, although within the Naval group it was found that older, longer-service men demonstrated a marked, though non-significant reduction in panic responses compared with the younger, shorter-service men. Male subjects who panicked scored significantly closer towards the unstable dimension of the stable/unstable scale of the Maudsley Personality Inventory developed by Eysenck.

The actual incidence of the "Panic' response varied between 17% and 42% over the groups, in other words, between one sixth and two fifths of the subjects demonstrated a willingness to save themselves at the expense of their fellow group members. A second general finding of considerable interest is that some subjects exhibited the 'panic response' very early in the experimental situation, for instance, nearly 20% of one group pressed the "escape" button within the first three seconds. These individuals did not appear to try and use the regular escape route in cooperation with the other group members, but "panicked" almost immediately.

A criticism which could be levelled at these experiments is that they in no way took account of differences in social-structure of the groups, which is considered to be a particularly important variable in real-life situations. The groups of subjects in these experiments would more correctly be described as .... "collectives". A further important point is that their opportunities for communication were either very low or non-existent. Let us examine these variables, social-structure and communication. If we consider two groups of individuals, say a football crowd and military unit, it is clear that we could much more easily describe the military unit in terms of relationship of the members to each other. The expectations, duties, obligations, responsibilities, courses of action in a given situation are very clearly defined by a set of rigid rules. In contrast the football crowd has little or no established hierarchy and is only a temporary congregation of individuals who have gathered for one particular purpose. Between these extremes of 'social structure', the casual, unorganised, crowd and the formal organised unit, one can conceive of all groups having their own 'structure', which if we had techniques sensitive enough, we could measure and quantify. As it is, we can compare in a general way the "structuredness" of groups and identify some of the variables which affect this characteristic. Clearly such things as the training of a group, the number in it, the presence of family or friendship ties, the establishment of leadership figures, formal areas of responsi-

bility, and lines of communication between group members are all of importance in determining the structure of the group. Some experimental investigations with relevance to a fire situation have been conducted in this area and I will briefly describe two of them. The first, which was carried out in 1941, was an attempt to study the differences between "organised" and "unorganised" groups in situations intended to produce "fear". (French, 1941). Eight organised groups composed of athletic teams were compared with eight unorganised groups composed of students who were not acquainted with each other. Each group contained six members. After a 45 minute session which was intended to produce frustration, by working on insoluble problems, each group was left alone in the experimental room to fill out a questionnaire. The doors to the experimental room were secretly locked and smoke was made to seep under one of the doors. After the group discovered the fire, a fire siren was sounded in a distant room to increase the illusion of a realistic fire situation. The behaviour of the groups was recorded by observers behind one-way screens, descriptions written afterwards by the subjects, and recordings of verbal behaviour.

The behaviour of the groups varied from apparently genuine fear to fairly complete scepticism or belief that the situation was a hoax. However, all the members of a group tended to react in the same way so that variability within the groups was significantly less than the variability between groups. The interaction of differing individuals within a group produced a "group atmosphere" which seemed to largely determine the reaction of all members of that group. Interestingly, the organised groups were definitely more frightened than the unorganised groups, however the validity of this conclusion is somewhat reduced because the two sets of groups were not matched for other factors such as educational ability and socio-economic class. Nonetheless it seems that the organised groups were not inhibited in their expression of fear to the same extent as the unorganised. This aspect is illustrated by a recent study which utilised a very similar experimental situation. (Kelley, 1965). Inevitably the subjects were again college students. (It has been estimated that some 75 to 80% of the experiments conducted in psychology are conducted with college students - subjects who clearly do not represent the population at large). The students were placed in an experimental room, ostensibly to complete a questionnaire. Smoke was then introduced into the room through a small vent in the wall. The smoke was injected into the room for the entire experimental period until by the end of the experiment, the vision was totally obscured by the amount of smoke present. If the subject left the room and reported the smoke the experiment was terminated. However, if the subject had not reported the presence of the smoke after a six minute interval from the time he first noticed it, the experiment was considered completed. The results of this experiment were interesting, since subjects in the room alone reported the smoke in 75% of the cases. When two passive confederates were provided for each subject, only 10% of the groups reported the smoke. When

the total experimental group consisted of three naive subjects, in only 38% of the groups did one subject report the smoke. Of the 24 persons involved in the eight naive groups, only one person reported the smoke within the first four minutes of the experiment. 55% of the lone subjects had reported the smoke within 2 minutes, and within 4 minutes, 75% of the subjects had reported the smoke.

It was reported that the perception of the smoke was apparently delayed by the presence of other persons, with the median time for noticing the smoke being five seconds when alone compared with a median time of 20 seconds for both of the group conditions. The delay in noticing the smoke undoubtedly reflects the constraints which persons accept as being imposed upon their behaviour in public places. These experimental results demonstrate quite clearly the influence of a small group on an individual's behaviour, since in the passive confederate group only one of the nine subjects involved reported the smoke. The behaviour of the naive subjects in the passive confederate conditions was described in the following terms. "The other nine stayed in the waiting room as it filled up with smoke, doggedly working on their questionnaire, and waving the fumes away from their faces. They coughed, rubbed their eyes, and opened the window, but they did not report the smoke".

The explanations given by the subjects who reported the smoke, and the subjects who did not report the smoke, as obtained in the post-experimental interview are reported as follows:

Subjects who had reported the smoke were relatively consistent in later describing their reactions to it. They thought the smoke looked somewhat strange, they were not sure exactly what it was or whether it was dangerous, but they felt it was unusual enough to justify some examination, "I wasn't sure whether it was a fire but it looked like something was wrong". "I thought it might be steam, but it seemed like a good idea to check it out".

Subjects who had not reported the smoke also were unsure about exactly what it was, but they uniformly said that they had rejected the idea that it was a fire. Instead, they hit upon an astonishing variety of alternative explanations, all sharing the common characteristics of interpreting the smoke as a non-dangerous event. Many thought the smoke was either steam or air-conditioning vapours; several thought it was smog, purposely introduced to simulate an urban environment! "

It is suggested that during the interpretation of the ambiguous threat cues, the individual is particularly susceptible to the behavioural reactions of other group members. If those around him remain passive and appear to interpret the situation as being a non-emergency, the individual will tend to have his interpretation modified by this social-inhibiting factor, and behave accordingly. There are three important points arising from this experiment. Firstly

that the actual perception of cues may be delayed by the presence of strangers. Secondly that the responses of an individual are closely related to his perceptions of how others are responding. And thirdly that the mere presence of others seems to reduce the likelihood of responding to a threat cue, as, if an individual is alone when an emergency arises then he is solely responsible for dealing with it. If others are present, particularly strangers, the individual may feel that his own responsibility for taking action is reduced. It is interesting to note that this "diffusion of responsibility" does not seem to be a function of group size, since it was observed in groups as small as three.

4.0 A Note concerning the Ethics of Social Experimentation.

We have seen in the previous two sections that the number of variables associated with the fire situation is extremely large.

With all these uncontrolled(and in some cases) uncontrollable variables, the question arises as to, "How are we going to study the behaviour of people in fires"?.

In terms of the whole population, fires in which people are involved are comparatively rare events. Consequently any attempts at direct observation of behaviour seems likely to prove unproductive. Is it possible then, to simulate fire conditions? We have seen that there have been isolated attempts to simulate the threat conditions implicit in fires. However the implications of such studies have recently been appraised in terms of their ethics and methodology. I have instanced some studies in which the aim of the experiment was to induce high level of stress in the subjects. If this aim was not achieved then the experiment would have been considered unsuccessful. Other experiments have gone even further. In one, an experiment designed to study the establishment of a conditioned response in a situation that is traumatic, but not painful, (Campbell, 1964) a drug was used to induce a temporary interruption of respiration in the subjects. The experimenters emphasise that,.. "This has no permanently harmful physical consequences, but is nonetheless a severe stress which is not in itself painful.." The subjects' reports confirmed that this was a "horrific" experience, and all the subjects in the standard series said that they thought they "were dying". The subjects, who were volunteer male alcoholics, were not previously warned of the effect of the drug. In another study conducted by the American military, (Berkun et al, 1962) a number of experimental situations were used to convince the subject that his life was in danger. In one situation, the subjects were passengers aboard an apparently stricken plane which "was being forced to ditch or crash land". In another the subject was led to believe that he was responsible for an explosion which "seriously injured another soldier". It is suggested that these, and other behavioural experiments involve potentially harmful psychological stress to subjects who are rarely, if ever, informed of this possibility. This might be particularly so in the case of nervous, anxious or other sub-clinically unstable individuals. Yet subjects appear never to have been examined prior to the experiment in an attempt to protect such people. If a realistic attempt were made at simulating a fire situation, the dangers might not only be psychologically damaging. One can envisage subjects suffering real physical harm in attempting escape activity. In one of the earlier-cited studies, the experiment was abruptly terminated when subjects attempted to break down a door. The corollary of this, is that we cannot simulate the real-life threat of a fire situation for ethical reasons. If, however, we take away the threat, then our simulation hardly justifies the term, since threat is considered to be a key intervening variable.

Having dismissed direct observation and simulation as possible methods of study, we will now consider the techniques which are available and which were used in the present study.

5.0 The Present Study

In undertaking a study of this nature it is important to consider the assumptions which are implicit in the statement of the problem. It is useful to examine it in terms of three main variables :

(a) the type of fire

(b) the type of building

(c) the type of behaviour

The "fire situation" in this context may be considered to be a combination of the first two variables. We assume that it is capable of being described and classified in some objective manner.

Let us consider our second assumption which is that the type of behaviour manifested in a fire is capable of being described and classified. We must first decide in what terms we wish to know about behaviour. Behaviour may be defined as the total response, motor and glandular which an organism makes to any situation with which it is faced. (Drever, 1952). Thus if we propound an Orwellian universe in which physical actions and physiological reactions are continuously monitored, then we have by this definition, described behaviour. Clearly in the present study we can neither monitor actions nor physiology of those involved in a fire. Even were it possible to make physiological measurements, our present knowledge is as yet so unrefined as to make it difficult to distinguish between certain affective reactions, and extremely difficult to quantify them. Therefore our definition of behaviour in the present case must be largely concerned with what people do, the actions they take. The essential problem then becomes one of how best to obtain this data.

5.1 Possible Methods of Research

As discussed in an earlier section, both direct observation and simulation were dismissed as viable means of data collection.

Consequently, less direct methods for the collection of information on behaviour in fires were considered. The first step in this procedure was to examine the existing data on fires, in the form of statistics and Research Reports. Regrettably these data-sources do not provide the detail necessary to study behavioural reactions. It would seem that detailed information is only obtainable from either actual participants in a fire, or "observers" of the fire. In this latter category would be included firemen, policemen, ambulance-men, newspaper-reporters and bystanders. It is clear that many of the "observers" will see only part of the events, either because they are not intimately involved in the dangerous aspects of the situation (as would be the case with bystanders or newsmen), or because at the time of the fire, their primary responsibility is the saving of lives, rather than objective observation of behav-

iour (in the case of firemen, policemen and ambulance-men).

It was thus decided that an attempt would be made to obtain first-hand information from the fire participants themselves.

The main techniques available for gathering such data are either the interview or the questionnaire. Both may be thought of as methods of "Indirect Observation" (Sjoberg, 1968), in which the social scientist does not actually observe a phenomenon, but relies upon other people who have observed or directly participated in it. The choice of either technique is dependent on a number of factors, such as manpower available, type of social phenomenon, hypotheses being tested, time scale, etc. The interview may be thought of as being an extremely flexible means of obtaining information, but with possible drawbacks involving small samples and difficulty in quantifying data. The questionnaire approach in contrast, usually involves a much more structured approach although this may be offset by its clear advantages in quantifying the resulting information.

5.2 First Pilot Survey

In our case we have seen that the range of possible fire situations, and the variables associated with them is extremely large. We have also seen that there is little previous field experimentation available from which it might be possible to derive testable hypotheses. It was thus decided that as an initial step an interview technique would be used in a pilot survey, which would attempt to gather some basic data and serve to define the breadth of the field, from which it might then be possible to use a more refined technique.

Interviews may vary in their degree of structuring, and in this case it was decided to use a reasonably unstructured format but what might be termed 'focussed'. Thus a number of questions would be common to each interview, but unsolicited information in any particular case would be noted. The advantages of this method are that all the information offered can be used and not rejected because it does not fall into a particular category and also it allows for a greater flexibility of questioning, thus permitting a more informal situation. The main disadvantages as already mentioned, are that each interview might take considerable time, and the more general point that the more unstructured the data-collection system the more difficult it is to quantify the data.

It was decided initially to restrict the survey to fires in certain types of building. These were, tall flats, (selected in an attempt to control at least one variable, the architectural features), hotels, because there appeared at the time to be a particular interest in such fires, and public places such as department stores, cinemas, halls, schools, hospitals and factories.

To this end several local Fire Brigades were contacted and it was explained to the Senior Officers which type of fires were of interest (as defined by me - "fires in the types of buildings outlined previously, which involve people, that is, people are present in the building at some stage of the incident"). A system was arranged whereby when a "fire of interest" occurred, I would be notified as soon as possible and could then trace and interview the participants. It was hoped that the maximum delay would be two days.

This system was in operation for a period of time but was eventually discarded for a number of reasons.

1. Small numbers. Six brigades within a reasonable area of Loughborough had been contacted for this part of the research. The number of fires of interest encountered by any of these within a period of 3-4 months would appear to have been small. Six incidents were visited.
2. Administrative. For unexplained reasons I was not contacted by some of the brigades when an incident did occur.
3. Lack of co-operation. An assumption of this study is that people will be prepared to talk about the incident. In the case of hotel fires for instance, it proved impossible to interview staff members or trace guests, due to the attitude of the manager. Similar difficulty was encountered at the one incident involving a cinema.
4. Time factors. In practice I arrived at the scene of the fire from a few hours after the fire up to 5 days after. Both periods were disadvantageous. Arriving soon after the fire in no obvious official capacity caused difficulties with police, firemen and participants. Longer periods of time involved difficulties in tracing participants, and lapses in recall.
5. Technique. It was found that responses were such that little disadvantage would occur if the interview became more structured.

Thus in this case the interview technique may be seen to be inappropriate as a method of data-gathering. The failure of this method was not complete, in that from the small amount of information gathered, at least an idea of the sort of areas of interest were gleaned, which could be further explored in the second Pilot Study.

5.3 Second Pilot Survey

The purpose of the second survey, like the first, was to (a) try out a possible method of collecting information on behaviour in fires, (b) bring to light possible key variables in this behaviour which could be studied in more detail in the main survey.

Following discussions with two Fire Brigades, it was decided to try and use the fire officers at the scene of the incident as initial gatherers of data. By this method it was hoped that the difficulties in administration, time factors, and small numbers outlined in 5.2 would be minimised. Apart from these obvious advantages, the co-operation of Fire Service personnel was also helpful with regard to the lack of co-operation mentioned earlier. Aside from the general suspicion of people in uniform, the Fire Brigade has, in the eyes of many of the public a much less ambiguous role than say a policeman. There are fewer of the legal overtones which might accompany questions by a police officer, the fireman being seen in a much more benevolent light, and thus hopefully more able to obtain correct information.

The two Brigades co-operating in the pilot survey represented different types of property at risk. West Riding Fire Brigade has a large number of mills and general industrial property. Warley Fire Brigade (Birmingham) has one of the largest concentrations of tall flats in the country.

The use of firemen as data gatherers indicated a simple questionnaire approach which could be administered in a short period of time. In fact two questionnaires were developed, very similar in principle but differing slightly to cater for the different occupancies. (Appendices 1 and 2).

The two questionnaires each had seventeen questions on them, broken down into six general areas

1) How the person first became aware of the fire
2) Their position in the building at that time
3) What they did as soon as they realised there was a fire
4) If or how they tried to leave the building
5) If they had any difficulty moving about due to smoke, flames, etc.
6) Where they were when the Fire Brigade arrived.

Results.

The survey was conducted over a period of 4-5 months. In all some 40 incidents were studied resulting in 92 completed questionnaires. We will only discuss the results briefly since the main purpose of the survey was as a technique-proving exercise.

First Awareness of the fire.

The most frequent methods by which a person became aware of the fire were:

1) Was told - 35%
2) Saw Flames - 21%
3) Smelt Smoke - 18%

The large percentage of people in (2) above tends to indicate that our sample is heavily weighted in favour of people who actually discovered the fire. This is further indicated by the fact that 41% of the interviewees judged themselves to be 'close' to the fire.

The first actions were classified into seven categories, as shown below.

Table 1

Category	%
Went to investigate	33
Prepared to leave	10
Warn someone else	20
Enquired if Fire Brigade called	10
Attempted call Fire Brigade	6
Tried to extinguish fire	13
Nothing	8

A methodological difficulty arose at this point in that it became clear that the action categories assigned on the questionnaire were too restrictive, that is the range of actions was larger than I had allowed for.

Points of interest in Table 1, are the relatively high percentage of people who warn someone else and the relatively low percentage who attempt to call the Fire Brigade.

With regard to evacuation of the building, one of the most interesting differences arose, in that in incidents in blocks of flats only 15% of those interviewed attempted to leave the building while in other buildings 60% of those interviewed attempted to leave.

58% of the interviewees stated that they had no difficulty moving about. As expected, smoke was the most frequent cause of difficulty (37% of the cases). Of the people who said they had difficulty moving through smoke, 65% stated that they moved 12 ft. or more.

When the Fire Brigade arrived only 8% of the interviewees from flats were outside the building, in contrast to the 45% from other buildings.

Finally, a rather surprising 24% of people claimed to have been previously involved in a fire incident.

The number of incidents and interviewees was too small to attempt to draw firm conclusions and this also precluded more detailed analysis on many of the questions. However, some interesting trends occurred.

(1) In blocks of flats women were significantly more likely to attempt to leave the building than men. (χ^2 signif. at 0.05)

(2) Men moved significantly further through smoke than women (χ^2 signif. at 0.02)

(3) The age of those interviewed appeared to have little effect upon their actions, whether or not they left or the distance they moved through smoke.

In summary, the second pilot survey served to demonstrate that information could be gathered using this method, and further indicated some of the areas in which the method might be refined.

5.4 The Full Scale Study

The method of data collection using Fire Brigade Officers having proven to be viable in the pilot study, a more detailed consideration of the factors of interest was now undertaken with the intention of using the same method for a much larger study. It was found convenient to consider then under four headings, fire variables, building variables, personal variables and action variables. There is inevitably some overlap between these categories, however the variables selected for study as being of particular interest are outlined under their headings below.

Fire Variables

(1) extent of fire

(2) position of fire in the building

(3) how extensive was the smoke

(4) how dense was the smoke

Building Variables

(1) what category of building

(2) what provision for fire in the building

(3) number of storeys

(4) (a) Number of people in the building

(b) Number of people who left, were rescued, were injured.

Personal Variables

(1) age and sex

(2) how the person first became aware of the fire

(3) how serious they considered the fire to be

(4) how familiar they were with the building layout

(5) how close they were to the fire

(6) how frequently they've received instruction or training on what to do in case of fire

(7) did they know any means of emergency escape from the building

(8) who was with them in the building

(9) have they been involved in a fire previously

Behavioural Variables

(1) what was the first thing they did

(2) what did they do subsequently

(3) did they leave the building

(4) did they return into the building

(5) did they try and move through smoke

(6) how far did they try and move through smoke

(7) did they have to turn back because of the smoke

It is not difficult to think of many other variables which might influence behaviour in fires, however the above-mentioned were selected to be of most interest and were thought to be of most importance. An additional factor was that it had been decided from an early stage that the final format of the questionnaire should not exceed one page for the Fire and Building variables and one page per person for the Personal and Behavioural variables.

The final selection of the chosen study variables was by no means arbitrary but based upon some of the factors outlined in sections 2.0 and 3.0, advice from Senior Fire Service personnel, and the declared areas of interest of the Fire Research Station.

An initial list of 130 simple hypotheses was constructed (Appendix D) and questions were constructed whereby these could be tested. The general hypothesis being of course that the variables under Fire, Building and Personal will be predictors of those under Behaviour.

One difficulty which arises concerns the general questions relating to actions taken. Due to the large number of possible actions it is necessary for these to be left unstructured, categories only being assigned subsequent to completion of the questionnaires. This greatly increases analysis time.

In order to obtain as wide a spectrum of behaviour as possible, six Personal-and-Behaviour questionnaires, labelled Part 2, were attached to each Building and Fire questionnaire, Part 1, the whole booklet being intended to refer to one fire incident. The final format

of the questionnaire is shown overleaf and a copy of a completed booklet is illustrated in Appendix E. The brief instructions for the use of the forms which is incorporated in the heading was supplemented by personal visits to the Fire Brigade and printed "Notes of Guidance" (Appendix F.)

Twelve Fire Brigades agreed to take part in the survey and personal visits were made to each Brigade to discuss the useage of the questionnaire and any possible difficulties which might arise.

To summarise this section, we had now developed a more comprehensive questionnaire which would investigate in considerable detail variables under headings of fire, building, Personal and Behavioural. These questionnaires were distributed to twelve Fire Brigades who would use them to interview people involved in fires at the scene of the incident, subsequently returning them to me for analysis.

5.5. Results

In this section it is intended to discuss the initial results of the survey in terms of descriptive statistics. More detailed analysis is conducted under section 5.6. It is convenient at this stage to consider items in approximately the order in which they appear on the questionnaire.

Data was collected from 952 fire incidents.

Figure 1. shows how this sample is related to the overall population of "Fire incidents".

Unfortunately official Fire statistics are not capable of being broken down into an equivalent population of "Fires in Buildings in which people are involved". The nearest official breakdown is the much larger population "Fires in Buildings". The present sample represents some 12% of this population over an equivalent period of time for the Brigades taking part in the survey. (Figures for 1969, the latest year for which statistics are available).

The time of occurrence of the incident was recorded as "time of first call to Fire Brigade". This was divided into four categories as shown in Table 2.

Table 2 - Incidents by Time

Category	% of incidents
morning (6 a.m. to noon)	22.4
afternoon (noon to 6 p.m.)	38.2
evening (6 p.m. to 11 p.m.)	25.4
night (11 p.m. to 6 a.m.)	14.0

The Behaviour of People in Fires

We are trying to find out if people react differently to fires in different kinds of building. This set of questionnaires is concerned with one particular incident and is composed of two parts.

Part I, which is about the fire and the building should be answered by the Fire Brigade Personnel. Part II comprises the six subsequent questionnaires, which are about people involved in the fire. The questionnaires in Part II are for use in interviewing six separate individuals who were in the building when the fire was discovered. We are interested in anyone who was in the building, not only the person who first discovered the fire.

We would therefore like you to interview as many people as possible who were involved with the incident. Both Part I and Part II should be handled by Fire Brigade Personnel, not by the person being interviewed. Where a question is followed by a list of suggested alternatives please tick the box opposite the most appropriate answer. Where a distance estimate is required please circle the relevant number.

Part 1 Information on the Building and Type of Fire

Address

Date

Time

K433 Report Sheet Number

1 Is a fire alarm (manual or automatic) provided in the building? ..... Yes ☐ No ☐

If so, was it used? ..... Yes ☐ No ☐

2 Is fire fighting equipment provided in the building? Yes ☐ No ☐

If so, was it used? ..... Yes ☐ No ☐

3 If fire fighting equipment is not provided, was any-other attempt made to extinguish the fire before the Fire Brigade arrived? ..... Yes ☐ No ☐

4 Are there any recognised escape routes in the building? ..... Yes ☐ No ☐

If so, were they used? ..... Yes ☐ No ☐

If "No", please specify why not

5 What category of building is it? *In general terms, for example – school, block of flats, shop, cinema, private dwelling house, multi-occupancy dwelling, etc.*

6 What is the maximum number of storeys in the building? ..... ☐

7 On which floor did the fire start?
Basement = –1, ground = 0, first = 1, etc. ..... ☐

8 Approximately how many people do you think were in the building when the fire was discovered?
Please put the number in the box ..... ☐
Approximately how many left the building during the course of the fire? *If all, write ALL* ..... ☐
How many people were rescued by Fire Brigade Personnel? ..... ☐
How many people were injured non-fatally? ..... ☐
How many people were injured fatally? ..... ☐
How many people were injured (fatally or non-fatally) in escaping the building? ..... ☐

9 How many
rooms were involved in the fire ..... ☐
levels were involved in the fire ..... ☐
constructions were involved in the fire ..... ☐

10 How many jets were utilised? ..... ☐

11 What was the extent of the smoke spread?
None ..... ☐
Confined to room of origin ..... ☐
Confined to floor of origin ..... ☐
Spread to floor above ..... ☐
Even more extensive ..... ☐

12 What was the density of the smoke at its worst?
If, on the scale below, 7 represents the thickest smoke you have ever encountered, and 1 represents very thin smoke, put a cross in one of the spaces which represents the density of the smoke in this incident.

1 ☐ ☐ ☐ ☐ ☐ ☐ ☐ 7

Part 2 Information about the Person in the Fire

Male ☐ Female ☐ Age ☐

1 How did you first become aware there was a fire?

Felt heat ☐
Saw flames ☐
Saw or smelt smoke ☐
Heard noises associated with the fire ☐
Heard shouts ☐
Was told ☐
Heard fire alarm or fire engines ☐
Something else *please specify*

2 When you realised there was a fire, how serious did you think it was?

Extremely serious ☐
Quite serious ☐
Not at all serious ☐

3 Which floor were you on when you realised there was a fire? ☐

4 Do you either live or work in the building? Yes ☐ No ☐

5 How familiar are you with the layout of the building?

Are you completely familiar with it ☐
fairly familiar with it ☐
slightly familiar with it ☐
not familiar with it ☐

6 What was the first thing you did when you realised there was a fire?

What did you do next?

and next?

7 How often have you received training on what actions to take in a fire?

At least once per month ☐
At least once every six months ☐
At least once every year ☐
Less frequently than once a year or never ☐

8 Did you know of any means of emergency escape in the building? Yes ☐ No ☐

9 Did you leave the building during the fire? Yes ☐ No ☐
If NO, please pass on to question 10

In leaving did you use

The normal exits ☐
An emergency exit ☐
Some other way *please specify*

Did you leave by Your own efforts ☐
With Fire Brigade help ☐
With the help of others ☐

Did you return into the building during the course of the fire? Yes ☐ No ☐

If you did, for what reason?

10 What reason did you have for not leaving? Was it because

You did not think the fire was serious enough ☐
You thought you would be safer where you were ☐
Some other reason *please specify*

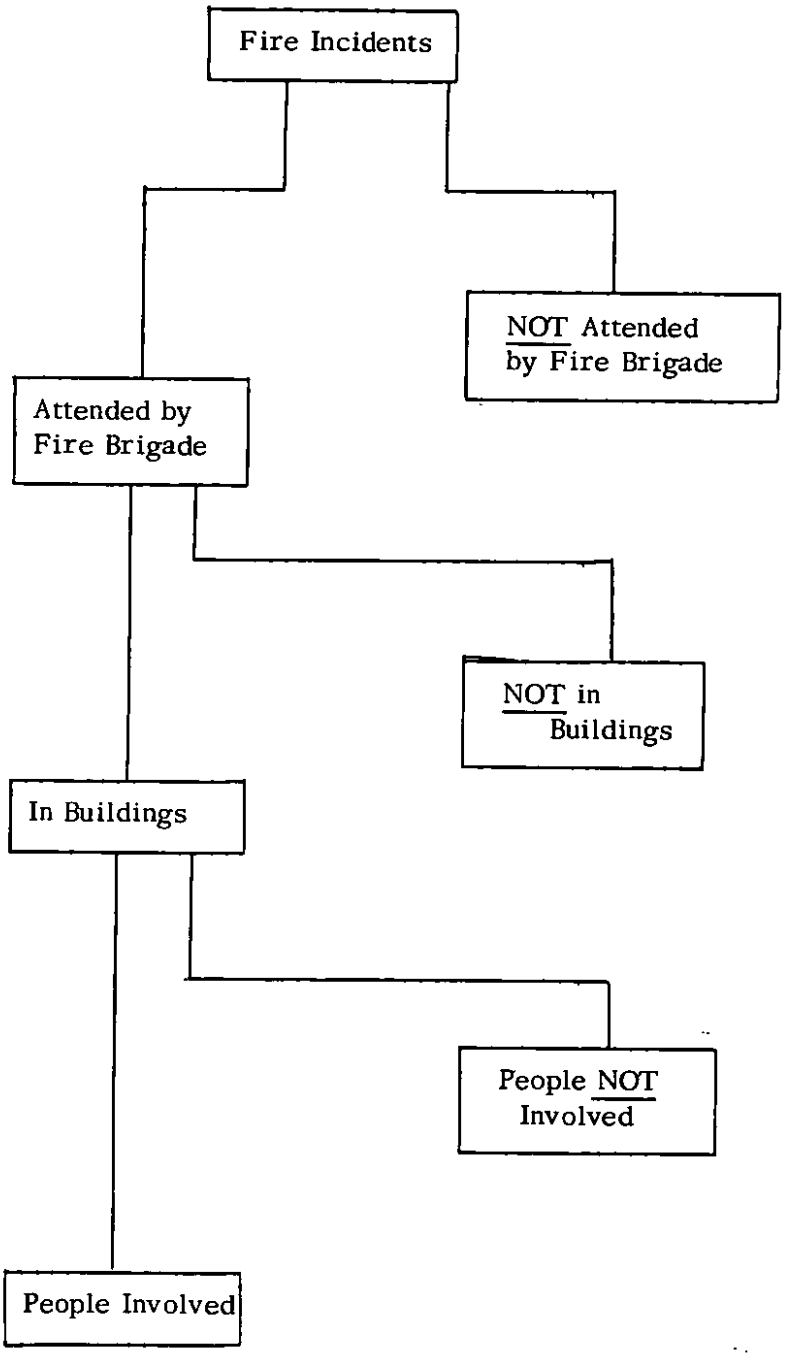
11 Was there any smoke? Yes ☐ No ☐
If NO, omit the rest of this question
Did you try to move through it? Yes ☐ No ☐
If NO, omit the rest of this question
How far did you try to move through it?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+
How far ahead could you see at the time?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+
Did the smoke become thicker? Yes ☐ No ☐
Did you have to turn back because of it? Yes ☐ No ☐
If NO, omit the next part of the question
How far ahead could you see when you turned back?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+

12 Were any of the following people with you in the building during the fire?

Your children under 12 ☐
Your children over 12 ☐
Your wife/husband ☐
Your parents ☐
Some other relative ☐
Friends ☐
Acquaintances ☐
People unknown to you ☐

13 Have you ever been involved in a fire incident before? Yes ☐ No ☐

Figure 1.


Fire Incidents
NOT Attended by Fire Brigade
Attended by Fire Brigade
NOT in Buildings
In Buildings
People NOT Involved
People Involved

5.5.1 Building Variables

5 What category of building is it? *In general terms, for example – school, block of flats, shop, cinema, private dwelling house, multi-occupancy dwelling, etc.*

The incidents were categorised by occupancy as shown in Table 3. The categories are based upon a more detailed breakdown of the Standard Industrial Classification. By combining our sample categories it is possible to derive a comparable classification. Doing this, and again using the sample "Fires in Buildings" for comparison, it would seem that the present sample has proportionately more dwelling houses than the official statistics do, but in other categories it is fairly comparable.

Table 3 - Incidents by Occupancy

Category	% of incidents
Dwelling house	50.6
Factory	16.7
Block of Flats	6.4
Multi-occupancy	4.4
School	0.7
Hotel	0.7
College	0.3
Shop (unspecified)	6.0
Public House	1.4
Fish and Chip Shop	1.2
Garage	1.9
Warehouse/store	1.6
Cafe/restaurant	1.2
Laundrette	0.5
Hostel/home	1.1
Office	0.6
Flat over shop, etc.	1.3
Hospital	1.3
Boiler House	0.4
Other	1.7

Some relevant information concerning the building was provided in the following questions.

Overall Percentages

1 **Is a fire alarm (manual or automatic) provided in the building?** ..... Yes ☐ No ☐	.....	22%
If so, was it used? ..... Yes ☐ No ☐	.....	55%
2 **Is fire fighting equipment provided in the building?** Yes ☐ No ☐	.....	38%
If so, was it used? ..... Yes ☐ No ☐	.....	68%
3 **If fire fighting equipment is not provided, was any-other attempt made to extinguish the fire before the Fire Brigade arrived?** ..... Yes ☐ No ☐	.....	55%
4 **Are there any recognised escape routes in the building?** ..... Yes ☐ No ☐	.....	47%
If so, were they used? ..... Yes ☐ No ☐	.....	53%

6 **What is the maximum number of storeys in the building?** ..... ☐

With blocks of flats representing only 6.4% of the incidents, it is unsurprising that buildings with less than 5 storeys make up more than 90% of the sample. Two storey buildings are the modal class.

7 **On which floor did the fire start?**
Basement = −1, ground = 0, first = 1, etc. ..... ☐

Almost 64% of the fires started on the ground floor, 22% on the first floor, 5% on the second, and 3% in the basement. All other values were of 2% or less.

8 **Approximately how many people do you think were in the building when the fire was discovered?**

Please put the number in the box ..... ☐ ..... (a)

Approximately how many left the building during the course of the fire? *If all, write ALL* ..... ☐ ..... (b)

How many people were rescued by Fire Brigade Personnel? ..... ☐ ..... (c)

How many people were injured non-fatally? ..... ☐ ..... (d)

How many people were injured fatally? ..... ☐ ..... (e)

How many people were injured (fatally or non-fatally) in escaping the building? ..... ☐ ..... (f)

(a) The average number of people per building was 18, however the modal class was only 2 per building. 9% of the buildings were occupied by only one person, 53% by three people or less, 78% by 10 people or less and 85% by 20 people or less. 2% of the incidents involved buildings in which more than 250 people were present.

(b) In 31% of the incidents nobody left the building. Again the average value at 5 is not very meaningful, the modal class in this case being 1 person leaving (20% of the incidents). Also with high values were 2 people leaving, 16% ; 3 people, 9% ; and 4 people, 6%. In 95% of the incidents 20 people or less left the building.

If we examine what percentage of people left the building we find that, as already stated, in 31% of the incidents no people left and in 49% everybody left, these two categories accounting therefore for 80% of the incidents. In 4% of the incidents, half the people left, the remainder being made up of groups with less than 2% in them.

(c) Overall the incidents studied, only 1.6% involved rescues by Fire Brigade personnel. The rescue of one to four people accounted for most of this figure, only two incidents involved rescuing 10 or more people.

(d) 6% of the incidents involved non-fatal injuries, one or two people injured being the largest category.

(e) Seven incidents involved a fatality. In each case one person only died. There were no multiple fatality incidents.

(f) 1.6% of incidents involved injury which occurred in escaping the building. Most of these involved only a single person.

5.5.2 Fire Variables

In order to obtain some measure of how severe the fire was the following questions were asked.

9 How many

rooms were involved in the fire .....

levels were involved in the fire .....

constructions were involved in the fire .....

10 How many jets were utilised? .....

More than 90% of the incidents were confined to one room (or area) on one level in one building.

29% of the incidents were sufficiently serious to require at least one Jet to be used.

As with Fire Severity, to obtain some measure of the smoke conditions in the building, the Fire Brigade were asked to judge how extensive and how dense the smoke was.

11 What was the extent of the smoke spread?

None .....

Confined to room of origin .....

Confined to floor of origin .....

Spread to floor above .....

Even more extensive .....

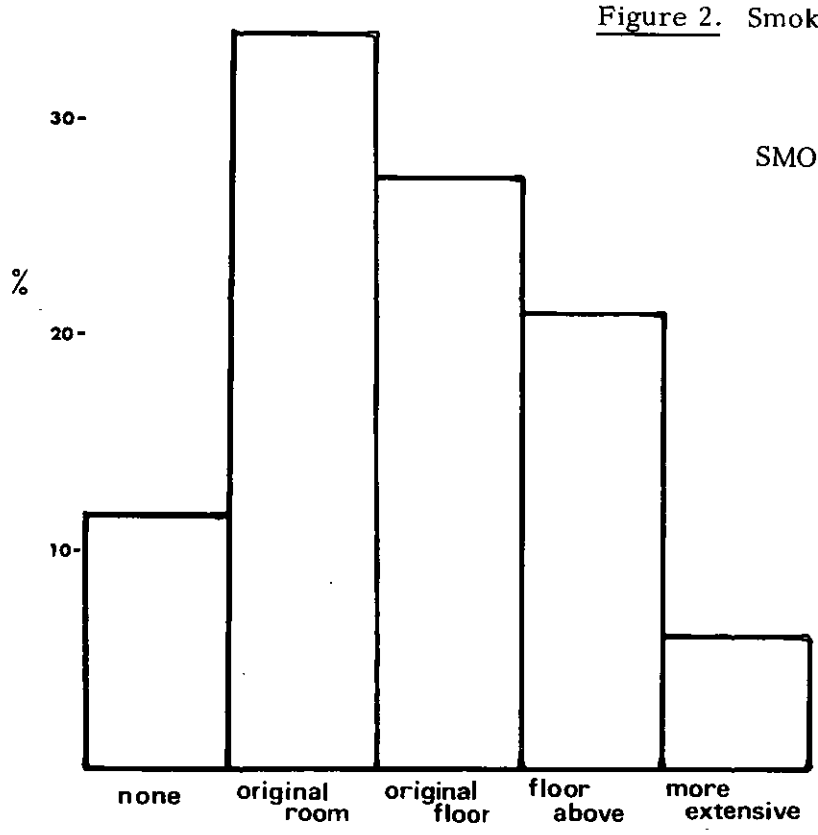
12 What was the density of the smoke at its worst?

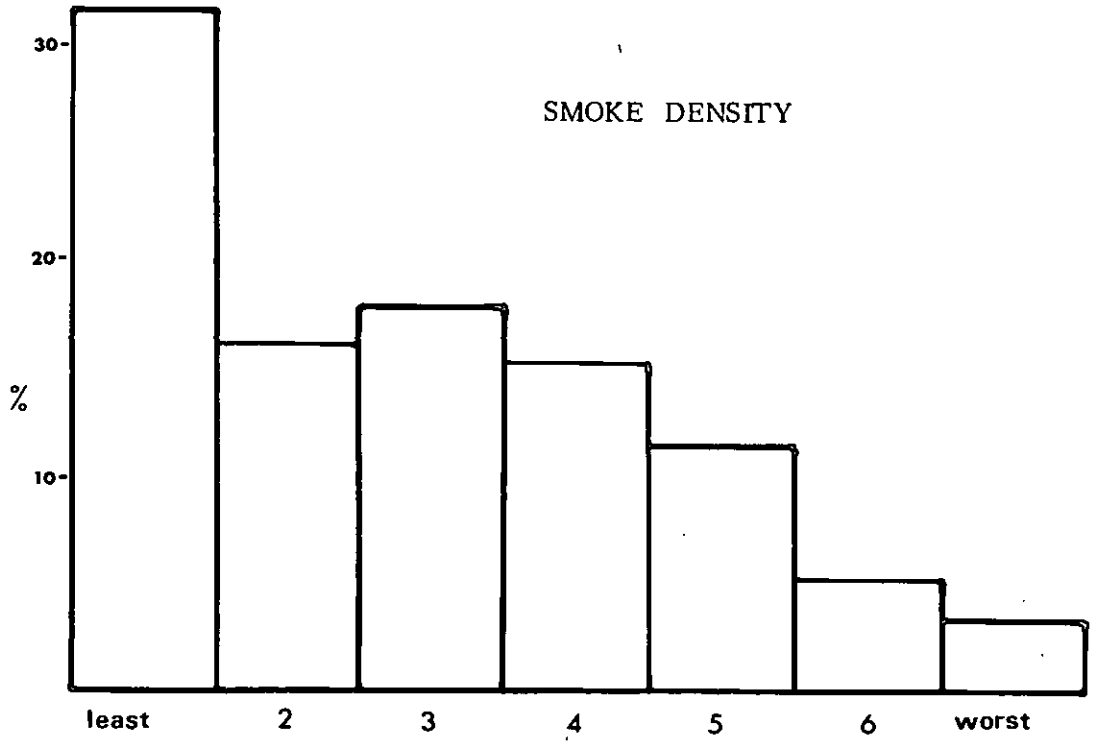
If, on the scale below, 7 represents the thickest smoke you have ever encountered, and 1 represents very thin smoke, put a cross in one of the spaces which represents the density of the smoke in this incident.

1 | | | | | | | | 7

The histograms in Figure 2 illustrate the distribution of these measures.

Figure 2. Smoke Spread and Density





5.5.3 Personal Variables

From the 952 fire incidents, 2193 people who were involved in them were interviewed using Part 2 of the questionnaire, 1239 men (56.55%) and 954 women (43.45%).

The distribution of ages of those interviewed approximates a normal distribution (Figure 3) although skewed to the younger end of the scale. The modal age group is 30 - 39 years.

How a person first became aware of the fire was considered to be a possibly important variable. People close to the fire would receive very clear cues indicating the presence of fire. Those some distance away would receive cues of a more ambiguous nature.

1 How did you first become aware there was a fire?

- Felt heat ☐
- Saw flames ☐
- Saw or smelt smoke ☐
- Heard noises associated with the fire ☐
- Heard shouts ☐
- Was told ☐
- Heard fire alarm or fire engines ☐

Something else *please specify*

☐

A histogram illustrating percentages in each category is shown in Figure 4. The categories are ordered in a general way on a scale of "proximity" to the fire. The perception of smoke and "being told" are clearly the most frequent cues.

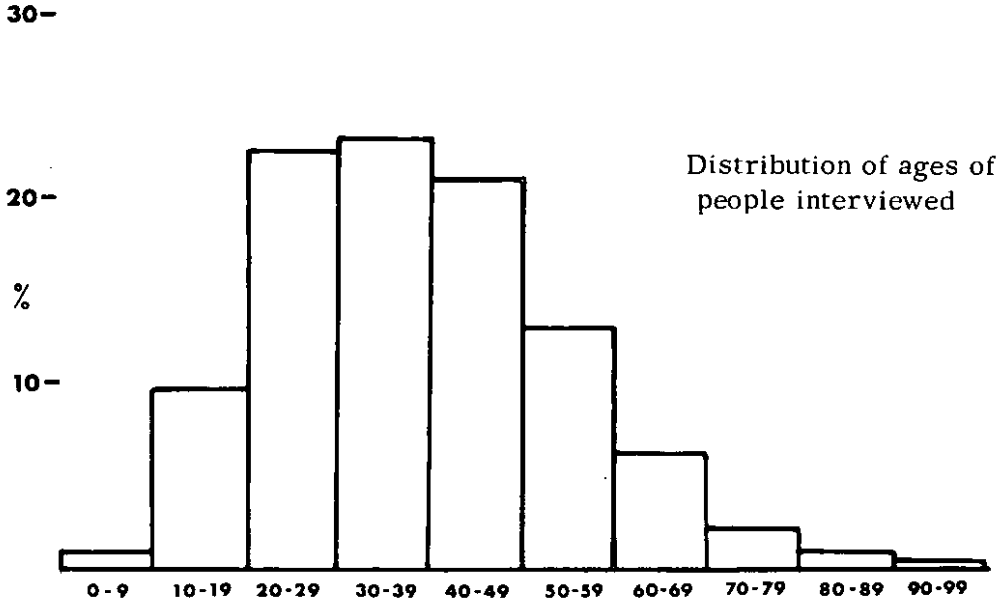
Interviewees were asked for a "seriousness rating" of the fire.

2 When you realised there was a fire, how serious did you think it was?

- Extremely serious ☐
- Quite serious ☐
- Not at all serious ☐

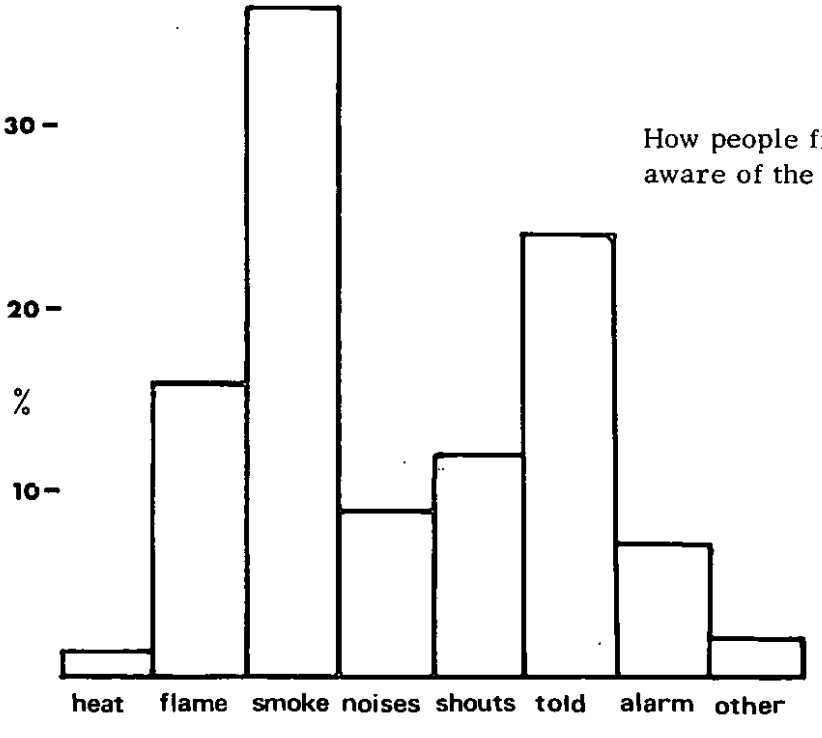
This question was included to obtain a crude measure of how subjectively threatened a person felt by the fire. From the discussion in Section 2.0, it would in general be considered that high levels of subjective threat are associated with very forceful threat-reducing behaviour, which might well be inappropriate in terms of a specific fire. Furthermore, it has been shown (Wherry & Curran, 1966), that people have individual thresholds for threat. It may be hypothesised that people with low thresholds are responsible for an initial "panic" reaction, or at least

Figure 3



Distribution of ages of people interviewed

Figure 4



How people first became aware of the fire

for less appropriate behaviour patterns. Clearly, rating a fire as 'extremely serious' may be associated with some objective variable, such as high smoke density, or the presence of young children, however these aspects will be explored in a later section. For the present we will merely illustrate the distribution of scale values as shown in Table 4.

Table 4 - Seriousness Rating of the Fire

Category	%
Extremely	20.2
Quite	50.4
Not at all	29.4

The floor on which the person was when he first became aware of the fire was then recorded. From this was then computed his position relative to the fire. Percentages are shown in Table 5.

Table 5 - Position of Fire relative to Person

Category	%
3 or more floors below	1.37
2 floors below	2.74
1 floor below	14.68
same floor	64.11
1 floor above	13.22
2 floors above	1.78
3 or more floors above	2.10

Clearly a large proportion of the people interviewed were on the same floor as the fire.

The following two questions were intended to explore a possible key variable, a person's familiarity with the building.

4 Do you either live or work in the building? Yes ☐ No ☐

5 How familiar are you with the layout of the building?
Are you ..... completely familiar with it ☐
fairly familiar with it .... ☐
slightly familiar with it .. ☐
not familiar with it ..... ☐

The first question was inserted as a lead-in to the familiarity scale. In fact only 10% of the people did not either live or work in the building. The potential importance of familiarity as a key variable was hypothesised on the basis of its likely effect upon such factors as use of escape routes, movement through smoke, and whether or not the person left the building. Percentages in each category are illustrated in Table 6.

Table 6 - Familiarity Rating

Category	%
Completely familiar	84.93
Fairly familiar	9.59
Slightly familiar	2.74
Not familiar	2.74

Thus a very large proportion of the people were completely familiar with the building. The small proportions in the other categories are perhaps a little disappointing, however it is probably not unrepresentative of people in fires in general.

Another possible key variable was investigated in the following question.

7 How often have you received training on what actions to take in a fire?

At least once per month ..... ☐
At least once every six months ..... ☐
At least once every year ..... ☐
Less frequently than once a year or never ..... ☐

The possible effect of training frequency upon almost all the behavioural variables is too obvious to necessitate listing.

Percentage frequencies are shown below.

Table 7 - Training Frequency

Category	%
At least once per month	5.76
At least once every 6 months	6.50
At least once every year	8.96
Less frequently than once a year, or never	78.77

An extension of this aspect, relating to a person's preparedness for fire was pursued in the next question.

8 Did you know of any means of emergency escape in the building? ..... Yes ☐ No ☐

64% of the people answered "YES" to this question.

Since the earlier-cited definition of panic behaviour requires it to be non-social, the investigation of Personal Variables would be incomplete without consideration of the presence of other people. This aspect was explored in the following question.

12 Were any of the following people with you in the building during the fire?

- Your children under 12 .. ☐
- Your children over 12 ... ☐
- Your wife/husband ..... ☐
- Your parents ..... ☐
- Some other relative ..... ☐
- Friends ..... ☐
- Acquaintances ..... ☐
- People unknown to you .. ☐

Again the categories are ordered in a general way on a "closeness of relationship" scale, although of course it is not a true scale as the categories are not mutually exclusive. This also explains why the percentages shown in Table 8 below sum to more than 100.

Table 8 - Presence of Other People

Category	%
Children under 12	17.24
Children over 12	8.07
Wife/Husband	20.61
Parents	6.98
Other relative	9.48
Friends	24.72
Acquaintances	36.07
People unknown	9.71

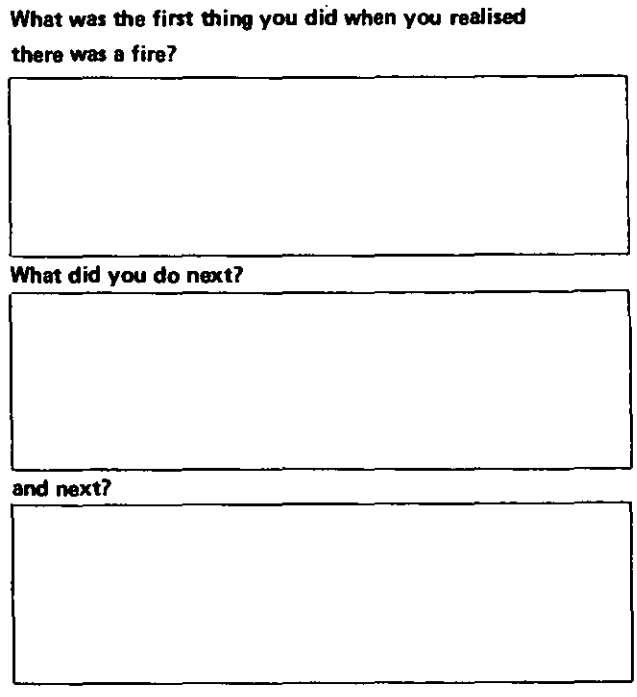
The final Personal Variable considered was whether or not the person had been pre-

viously involved in a fire incident. The term "fire incident" was not defined, nor was the time scale indicated, which may account for the surprisingly high proportion of nearly 30% of the interviewees claiming to have been previously involved. As the Pilot survey revealed a figure of 24%. it may be hypothesised that the chances of being involved in a fire incident are quite unevenly distributed throughout the population.

5.5.4 Behavioural Variables

The scrutiny of the Behavioural Variables posed the most difficult problems of the investigation. It has been demonstrated in the second Pilot Survey that a format involving pre-assigned response categories was too inflexible to explore the wide variety of behaviour. Conversely, a completely unstructured response is not only difficult to quantify, but may well omit areas of particular interest to the experimenter. In an attempt to obtain the best compromise, both types of question were included. A series of general questions were asked concerning behaviour; followed by specific questions concentrating on two aspects, evacuation of the building and movement through smoke.

The general questions were of the form shown below.



After the questionnaires were returned to me each "action" was coded for each of the above questions. The category into which each action was assigned was intended to be of a general descriptive nature, thus for instance, almost all attempts to verify the nature or seriousness of the fire would fall into the general category .... "Investigate". Using this method of coding, the response for each of the above questions were reduced to the 29 categories shown below.

Table 9 - General Behaviour during incident

	Category	% First Action	% Second Action	% Third Action
1.	Investigate fire	12.18	2.23	0.68
2.	Contact Fire Brigade	10.12	11.13	8.48
3.	Move away from fire	1.82	2.14	1.41
4.	Move towards fire	5.61	3.15	1.23
5.	Warn other people	8.07	3.60	1.14
6.	Move towards exit	1.64	1.37	0.32
7.	Leave building	7.98	8.80	8.39
8.	Some fire-fighting action	14.91	18.33	12.36
9.	Something to minimise the risk	2.96	1.41	1.28
10.	Save personal effects	1.19	0.96	0.96
11.	Raise general alarm	2.74	1.14	0.18
12.	Organise evacuation	1.78	1.69	1.00
13.	Request help from others	2.23	2.37	1.46
14.	Give help to others	1.73	2.74	1.46
15.	Await rescue by Fire Brigade	0.00	0.14	0.50
16.	Something which increases the risk	0.59	1.05	0.82
17.	Attempt to rescue someone	0.18	0.36	0.27
18.	Return into the building	0.05	2.23	2.05
19.	Switch off gas/electric services	4.10	2.55	1.60
20.	Contact someone in authority	2.14	2.10	1.37
21.	Shut door(s)	3.10	4.01	2.23
22.	Get family out of building	5.43	3.56	1.50
23.	Move the burning object	1.23	1.64	1.19
24.	Get dressed	2.23	0.64	0.18
25.	Assist Fire Brigade	0.05	0.50	1.23
26.	Enquire if Fire Brigade sent for	2.83	3.33	2.14
27.	Move to a safe place (within bldg)	0.78	1.46	1.32
28.	Cover face with wet towel, etc.	0.18	0.41	0.09
29.	Inaction (watch others etc.)	2.14	14.96	43.14

The categories in Table 9 represent an exclusive list of the actions taken by the interviewees. It will be seen that the categories are not all of the same type, some being of a more general nature than others. It is possible to combine categories into more general classes although of course much of the detail is lost in this process. Such combinations have been made in the analysis where it is necessary to illustrate specific points.

In this preliminary analysis there are two main ways in which the data on actions may be examined.

(1) We can look at each individual column in Table 9, representing an ordered action separately.

(2) We can consider the combinations of first, second and third actions, representing a course of action.

We will discuss the data only very briefly by the method in (1) above, since examining each action separately is of only limited value. We will obtain a more meaningful description of behaviour when we take into consideration how actions relate to each other.

Let us then look briefly at the individual columns.

The five most popular first actions are

(1) Some fire-fighting action

(2) Investigate fire

(3) Contact Fire Brigade

(4) Warn other people

(5) Move towards fire

The high position accorded to "some fire-fighting action" may be partially due to the more general nature of this category, which would include activities expressing the intention of fighting the fire. However such distinctions seem rather debatable and the essential point remains that nearly 15% of those interviewed were prepared to "attack" the fire as a first action.

As an initial action we would expect many people to attempt to verify the nature of the fire, so the position of "Investigate" is unsurprising.

The ordinal position of "contact Fire Brigade" is gratifying although the lowly percentage much less so.

Similarly for "warn other people", which is of course a very socially responsible action, far removed from 'inappropriate behaviour'.

"Move towards fire" is a rather difficult category since it is like "fire-fight", a very

general category, but one in which the intention is not clear. Such an action may be either investigative or the precursor of active fire-fighting.

The picture changes somewhat if we combine categories. For instance combining categories 9, 19 and 21, all facets of a wish to minimise the danger, this becomes the third most popular action.

Combining categories 2 and 26 raises the general category concerned with contacting the Fire Brigade to second most frequent action.

A revised list with other combinations is shown below.

(1) Some fire-fighting action
(2) Contact Fire Brigade (combining 2 + 26)
(3) Investigate
(4) Warn Others (combining 5 + 11)
(5) Something to minimise danger (combining 9, 19, and 21)

These five rather more general categories account for more than 60% of first actions. If we add a further two categories

(6) evacuate oneself from building (combining 6 and 7)
(7) evacuate others from building (combining 12 and 22)

we have described nearly 80% of the first actions in these seven classes.

A list of the five most popular second actions is shown below

(1) Some fire-fighting action
(2) Inaction
(3) Contact the Fire Brigade
(4) Leave building
(5) Shut doors

The three categories "Investigate", "Move towards fire", and "Warn other people" have dropped completely from this top five. We would have expected the former two categories to become the less frequent, but clearly warning other people, if it is not thought of to start with, is hardly thought of at all. The large numbers in "Inaction" are derived in large measure from these three initially popular categories, since other percentages in the column remain fairly stable.

In comparing between first and second actions it is interesting that the types of first actions taken seems to be more variable. For instance the number of actions with more than 5% in them (that is 100 people) is 7 in column one and only 4 in column two. Also the most popular four actions in column one account for 45% whereas the most popular four in column two

(although not the same four actions), account for 53%.

From this it would seem that behaviour during a fire becomes more "stereotyped", certain actions being chosen by progessively more people. This trend is continued in column three, in which the most popular four actions shown below account for 72% of the behaviour.

(1) Inaction

(2) Some fire-fighting action

(3) Contact Fire Brigade

(4) Leave building

(5) Shut doors

Apart from the reversal of the first two categories this list is the same as that for the second column. The most striking thing about this column is the enormous increase in numbers of people who adopt some form of "passive" behaviour, which is classed here as "Inaction". Aside from the actions in (2), (3) and (4) immediately above, this increase in passive behaviour appears to be at the expense of all other action categories.

Let us now look at the results of how actions combine to form courses of action. Since the actions are not mutually exclusive then for our 29 categories in each group there are 29^3, i.e. 24,389 possible courses of action. On this basis one might be excused for wondering if any two people from our sample of 2193 would have the same combination of all three actions. However definite patterns do emerge although our fine division of action categories is inapplicable at this stage.

Inspection of the combinations of actions reveals that there are three underlying general types of reaction to fire:

(a) concern with evacuation of the building either by oneself or with others

(b) concern with fighting, or containing the fire

(c) concern with warning or alerting others, either individuals or the Fire Brigade.

The majority of the behaviour falls either exclusively into one of these categories, or into some combination of them. The most frequent courses of action are in fact directed solely to one end, in this case either leaving the building or fighting the fire. Approximately 5% of the interviewees were inactive during the course of the incident.

In general terms, the majority of people appear to have behaved in what might be considered an appropriate fashion, although some 5% of the people did something which was judged to "increase the risk", including the apocryphal 'looking for a gas leak with a lighted match'. Perhaps the most common fault was opening windows "to clear the smoke". A similar

percentage of people attempted to move the burning object, often a chip-pan, and therefore sustained burns or in some cases caused the fire to become more serious. We now turn to the specific behavioural questions concerned with evacuation of the building and movement through smoke. Those concerned with the former are shown below.

9 Did you leave the building during the fire? ..... Yes ☐
If NO, please pass on to question 10 No ☐

In leaving did you use

The normal exits ..... ☐

An emergency exit ..... ☐

Some other way *please specify*

Did you leave by ..... Your own efforts ..... ☐

With Fire Brigade help .. ☐

With the help of others .. ☐

Did you return into the building during the course of the fire? ..... Yes ☐
No ☐

If you did, for what reason?

10 What reason did you have for not leaving? Was it because

You did not think the fire was serious enough ..... ☐

You thought you would be safer where you were ... ☐

Some other reason *please specify*

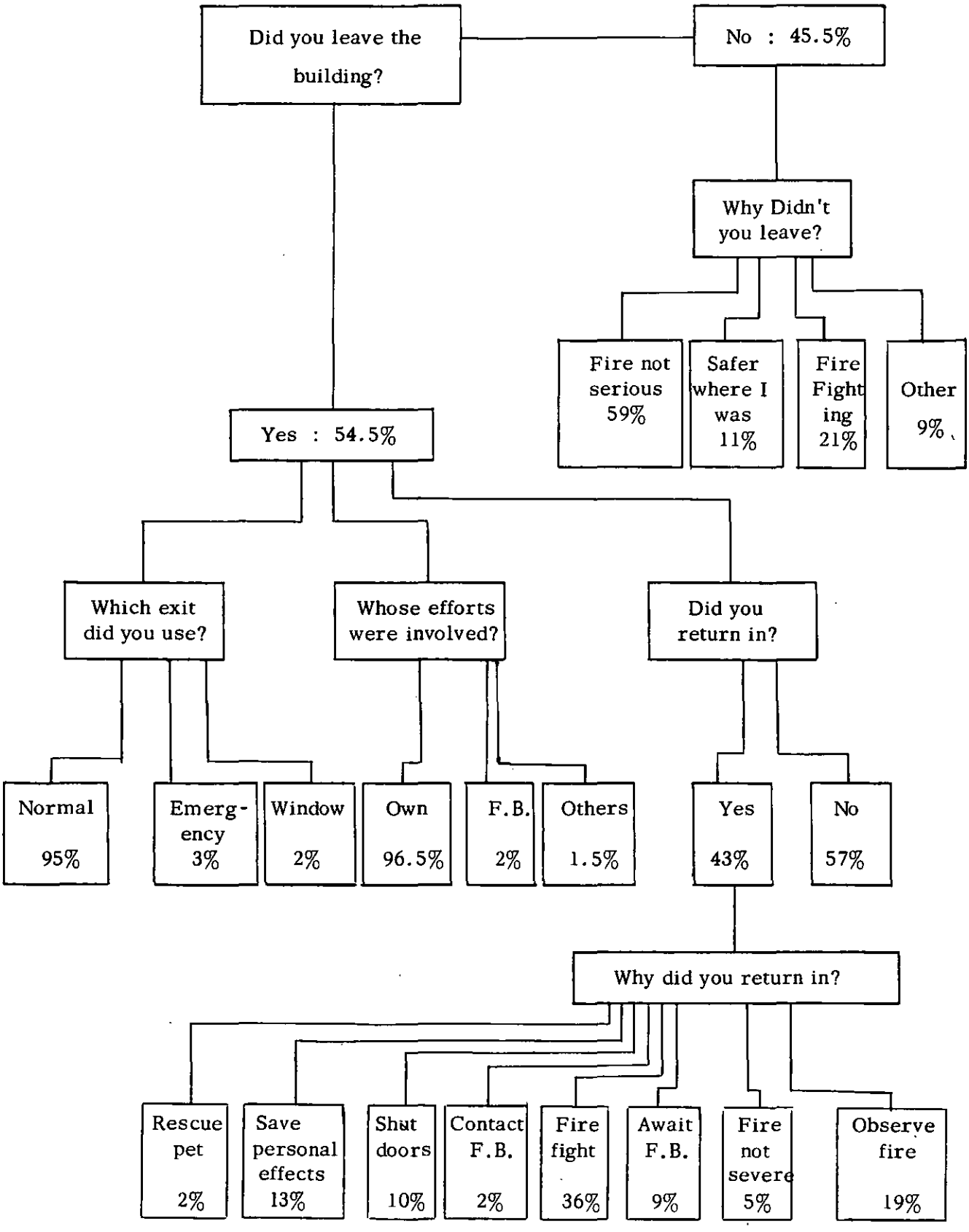
The results of these questions are illustrated in the question/response chart shown in Figure 5. Some interesting points arise from this analysis.

(a) Although recognised escape routes were present in 46% of the buildings, only 3% of those who left did so using an emergency exit.

(b) Of people who didn't leave the building, in 70% of the cases their reason for not doing so reflected a low-threat assessment of the fire. Nearly 50% of these people had initially rated the fire as "not at all serious", so in those cases their judgement of the threat imposed by the fire remained stable during its course.

(c) A startling 43% of those who left returned into the building.

Figure 5


Did you leave the building?
No : 45.5%
Why Didn't you leave?
Fire not serious 59%
Safer where I was 11%
Fire Fighting 21%
Other 9%
Yes : 54.5%
Which exit did you use?
Whose efforts were involved?
Did you return in?
Normal 95%
Emergency 3%
Window 2%
Own 96.5%
F.B. 2%
Others 1.5%
Yes 43%
No 57%
Why did you return in?
Rescue pet 2%
Save personal effects 13%
Shut doors 10%
Contact F.B. 2%
Fire fight 36%
Await F.B. 9%
Fire not severe 5%
Observe fire 19%

(d) The reasons given for returning-in, accurately reflect the threat- reducing effect of leaving the building, which was discussed in section 2.0. Almost all the reasons demonstrate a "second thought" type of response. One can hypothesise that these people represent those whose immediate reaction was to leave the building. Once outside, a more 'rational' attitude prevails, they perhaps recall things they should have done, or question their initial assessment of the fire, and thus return in.

Movement through smoke was explored in the following questions.

11 Was there any smoke? ..... Yes ☐
If NO, omit the rest of this question No ☐
Did you try to move through it? ..... Yes ☐
If NO, omit the rest of this question No ☐
How far did you try to move through it?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+
How far ahead could you see at the time?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+
Did the smoke become thicker? ..... Yes ☐
No ☐
Did you have to turn back because of it? ..... Yes ☐
If NO, omit the next part of the question No ☐
How far ahead could you see when you turned back?
Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+

The results of these questions are shown in Figure 6. Histograms of distances are illustrated in Figure 7. Points of interest are:

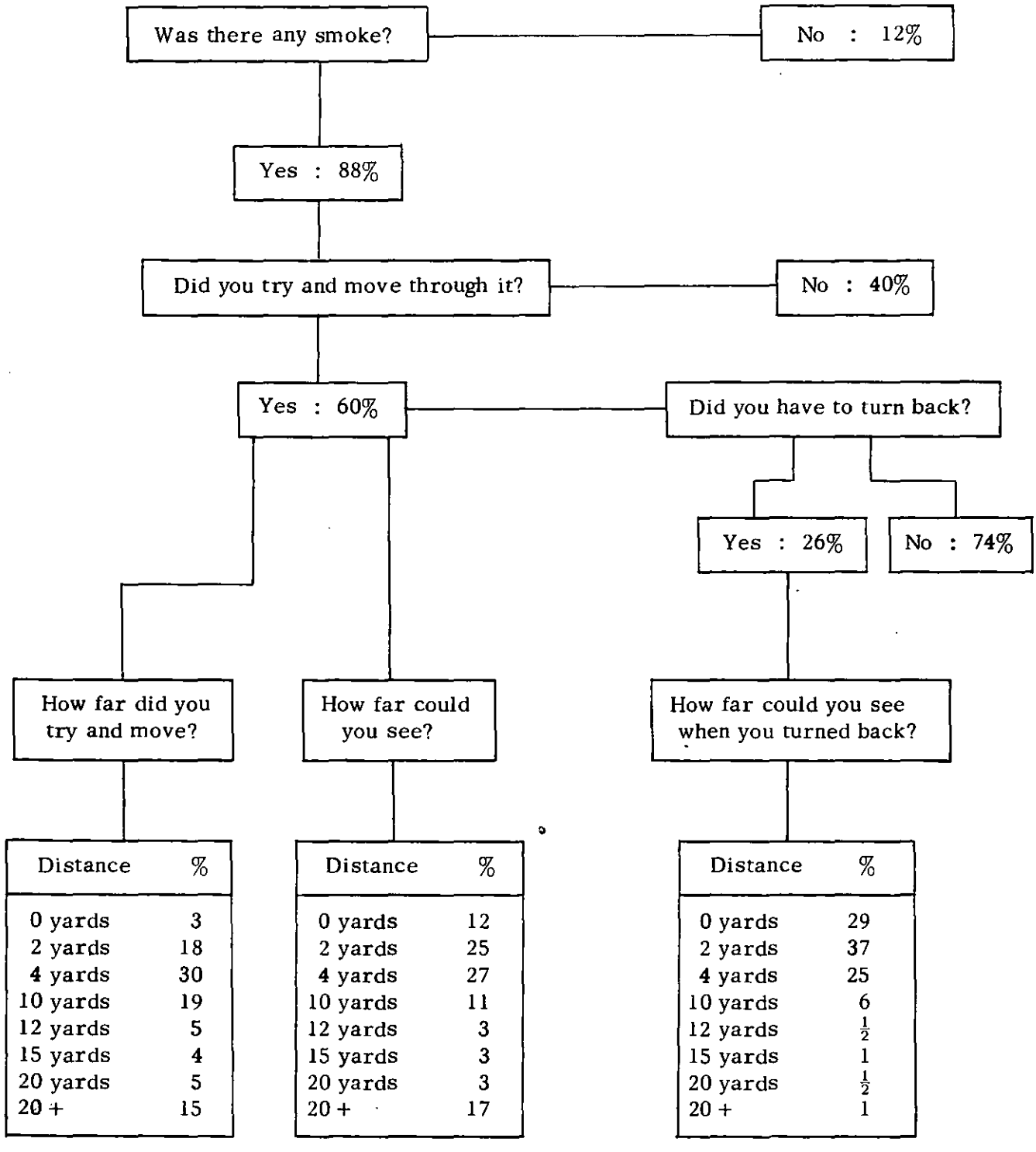
(a) For incidents in which smoke was present, 60% of the people were prepared to move into it. This is an extremely interesting result in view of the widespread belief that people will not enter smoke.

(b) The shapes of the histograms in Figures 7 (1) and 7(2) are fairly similar which could indicate that people will move through smoke only as far as they can see ahead, although this relationship is explored in a later section.

(c) As would be expected, visibility estimates of people who turned back are concentrated at the 'low' end of the scale, i.e. 4 yards or less.

This completes the preliminary analysis of the data. We will now consider certain aspects in more detail.

Figure 6

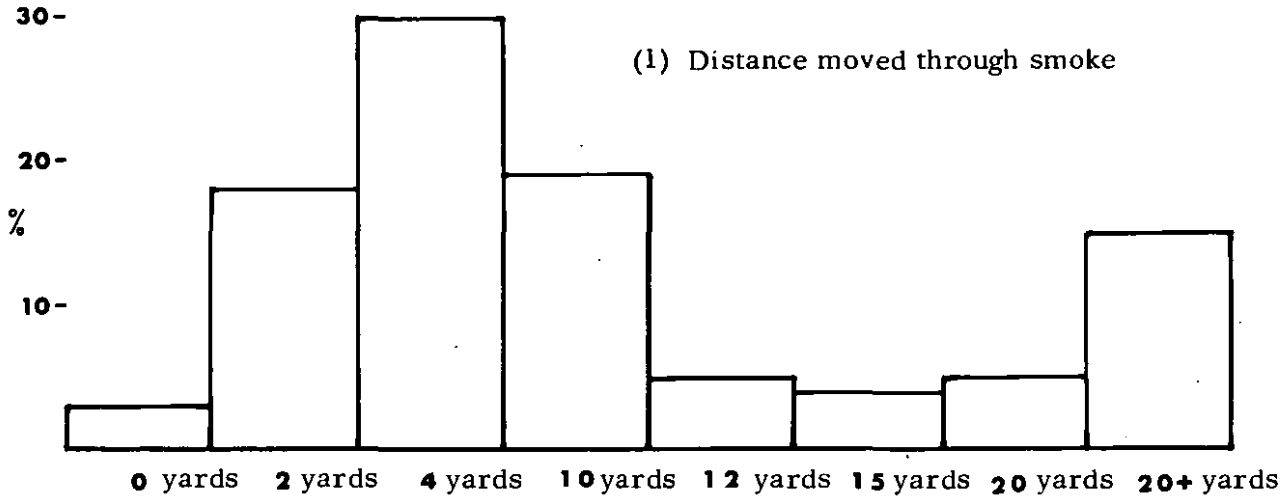


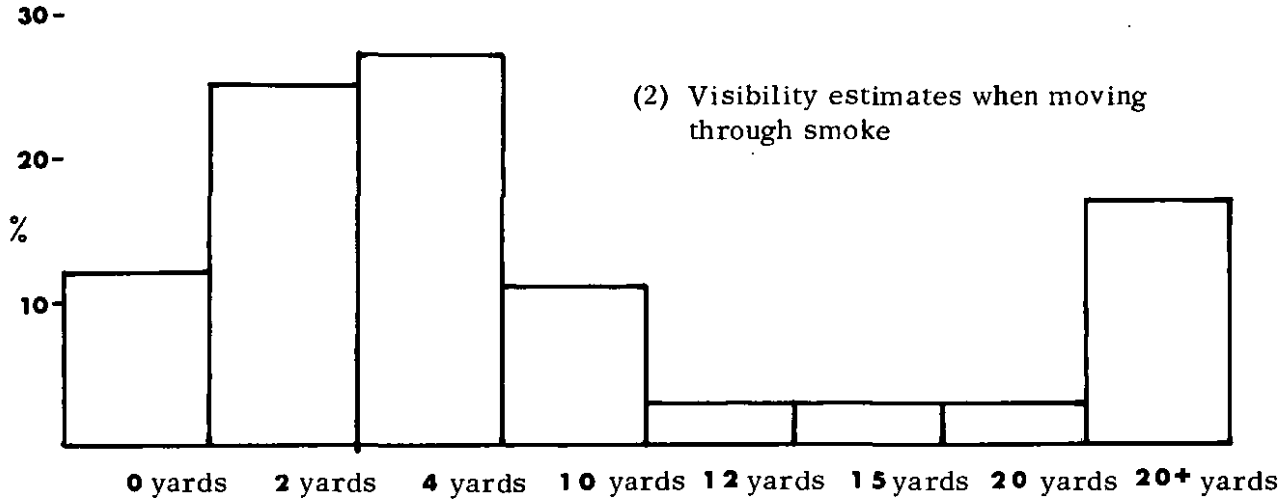
Distance	%
0 yards	3
2 yards	18
4 yards	30
10 yards	19
12 yards	5
15 yards	4
20 yards	5
20 +	15

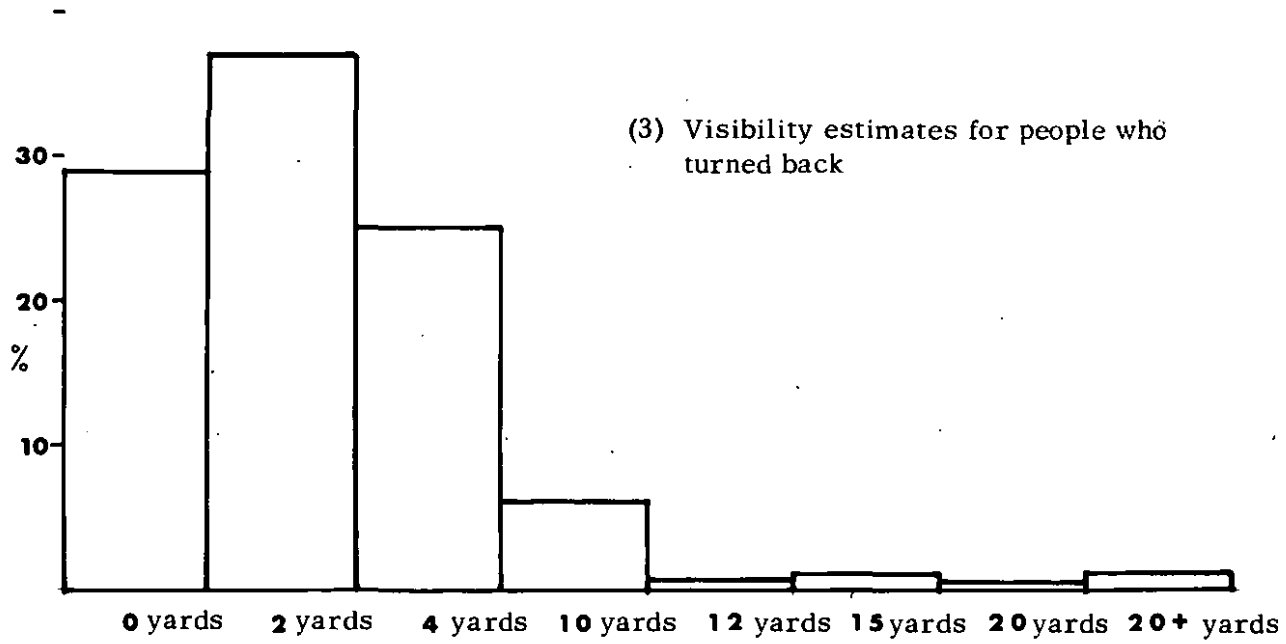
Distance	%
0 yards	12
2 yards	25
4 yards	27
10 yards	11
12 yards	3
15 yards	3
20 yards	3
20 +	17

Distance	%
0 yards	29
2 yards	37
4 yards	25
10 yards	6
12 yards	$\frac{1}{2}$
15 yards	1
20 yards	$\frac{1}{2}$
20 +	1

Figure 7


30-
20-
%
10-
(1) Distance moved through smoke
0 yards
2 yards
4 yards
10 yards
12 yards
15 yards
20 yards
20+ yards


30-
20-
%
10-
(2) Visibility estimates when moving through smoke
0 yards
2 yards
4 yards
10 yards
12 yards
15 yards
20 yards
20+ yards


30-
20-
%
10-
(3) Visibility estimates for people who turned back
0 yards
2 yards
4 yards
10 yards
12 yards
15 yards
20 yards
20+ yards

5.6 Detailed Analysis

In the preliminary analysis we have given a descriptive account of how the interviewees behaved. In the following section we are attempting to identify which of the key variables outlined previously are important in determining this behaviour.

Since we are interested primarily in what people do, we will begin by examining in some detail the relationship between First Action taken and other variables. Subsequent analysis will be discussed more briefly. The following variables were selected for consideration:

(1) How the person first becomes aware of the fire
(2) How serious the person rates the fire
(3) How familiar they are with the building
(4) How frequently they have had instruction on fire
(5) What category of building they are in
(6) Whether or not escape routes are provided
(7) Presence of smoke
(8) Extent of smoke spread
(9) Presence of other people
(10) Whether or not a person has been previously involved in a fire incident
(11) Sex
(12) Age

In the subsequent sections, the titles of analyses will be abbreviated to the form, ... "First Action/Age". This indicates that we are analysing the sample into various age groups and investigating if they differ in their First Actions. Our null hypothesis would be of course that there was no difference between the age groups in their First Actions. Any disparity which emerges in the analysis would then be tested to see if it deviates significantly from chance. (In some cases the significance testing is not possible because of low values in certain categories).

(1) First Action/First Aware

We have a dual interest in the variable "how a person first becomes aware of the fire". In some of the previously recorded "panic" incidents, the appearance of panic has been related by earlier investigators to the sudden appearance of very strong manifestations of fire. On this basis we would expect that a greater proportion of people who received very clear cues would leave or attempt to leave the building as their first action.

In our discussion of previous work we also saw how the ambiguous nature of cues may lead to a delay in compensatory reaction. If we use 'fire-fighting activity' as our measure of

compensatory action, then we would expect it to occur more frequently in groups responding to 'non-ambiguous cues' than in those responding to 'ambiguous cues'.

Table 10 shows the complete breakdown of actions by method of first awareness. Due to the small values in some of the cells it is not possible to do significance tests for all categories. However by combining groups we may test the two hypotheses outlined above.

	clear cues	ambiguous cues
move towards exit or leave	97	122
all other categories	1038	918

This yields χ^2 value 6.14 with 1 d.f., which is significant at the .02 level.

However the result is the reverse of which we predicted, in that a significantly greater proportion of the ambiguous-cue group left than the clear-cue group. The reason for this may be explained if we examine Table 10, in which we note that a large proportion of the 'Alarm' group had as their first action "leave building", which is presumably the correct procedure for many people in the work situation. Thus our selection of "leave building" as an indication of panic-type reaction is in this case incorrect.

Testing our second hypothesis yields the contingency table below.

	non-ambiguous	ambiguous
fire-fight	201	121
all other categories	934	919

This yields a χ^2 value of 15.9 with 1 d.f., which is significant at the .001 level. Thus our hypothesis that compensatory action as typified by fire-fighting is more likely to occur as a first action when the cues are "clear" rather than "ambiguous" is upheld.

Other interesting points which arise from a study of Table 10 are,

(a) The increasing proportion of people who "investigate" as the proximity to the fire decreases. One assumes that the large proportion in the 'alarm' group are not following correct procedure.

(b) the trend towards proportionately less people contacting the Fire Brigade as proximity to the fire decreases.

Table 10 - Initial Awareness of Fire by First Action.

	Method by which first became aware of the fire							
	'Unambiguous cues'			'Ambiguous cues'				
First Action	Heat (%)	Flames (%)	Smoke (%)	Noise (%)	Shouts (%)	Told (%)	Alarm (%)	Other (%)
Investigate	4	3	13	12	13	15	24	
Contact Fire Brigade	14	10	10	13	7	11	6	
Move away fire	7	2	2	2	1	1	2	
Move towards fire	0	1	5	3	12	7	10	
Warn others	11	13	9	7	11	4	1	
Move towards exit	0	1	1	2	3	2	1	
Leave building	7	6	6	11	9	8	19	
Fire-fighting	18	24	15	10	14	12	9	
Minimise risk	4	4	3	3	1	3	7	
Save effects	7	1	1	1	1	2	1	
Raise alarm	7	6	3	2	1	1	1	
Organise evacuation	4	1	1	3	2	2	6	
Request help	0	3	3	1	0	1	2	
Give help	0	0	1	1	2	3	2	
Await rescue	0	0	0	0	0	0	0	
Maximise risk	0	0	1	1	0	1	1	
Attempt rescue	4	0	0	0	0	0	0	
Return in	0	0	0	1	0	0	0	
Switch off mains	4	6	6	4	1	2	0	
Contact authority	0	2	2	3	0	2	0	
Shut doors	0	3	4	5	2	3	2	
Evacuate family	7	2	5	8	7	8	0	
Move burning object	4	3	2	0	0	1	0	
Get dressed	0	1	1	3	5	3	2	
Assist Fire Brigade	0	0	0	0	0	0	1	
Enquire if F.B.contacted	0	3	3	4	3	3	1	
Move to safe place	0	0	0	1	1	1	3	
Cover face with cloth	0	0	0	0	0	0	0	
Inaction	0	2	1	0	3	4	2	

Column 'other' has been left blank due to the small number of responses rendering percentage calculations meaningless.

(2) First Action/Seriousness Rating

As mentioned earlier, we are interested in seriousness rating because it may be regarded as a measure of how subjectively threatened a person feels by the fire. From our earlier discussion we would expect that the more threatened a person feels, the more likely that his first actions will be strongly directed towards reducing this subjective threat level. Both "Fight and/or Flight" reactions may serve this purpose. We would therefore expect an increasing tendency for people to indulge in these activities as their 'seriousness rating' increases.

Table 11 shows the complete breakdown of action by seriousness rating. Again by combining categories we may test our hypotheses. We note however that although the proportion of people leaving the building or moving towards the exit increases with seriousness rating, the proportion of people fighting the fire or moving towards the fire decreases on this variable. We may test the significance of these proportions by testing columns against each other, however in this case testing significance of the trend is more appropriate. Appropriate contingency tables are shown below.

	not serious	quite serious	extremely serious
leave the building or move to exit	55	100	56
all other categories	590	1005	385

This yields a χ^2 for the trend of 4.680 with 1 d.f., which is significant at 0.05 level.

There is thus a significant trend for an increasing proportion of people to leave the building as a first action, the more serious they consider the fire to be.

	not serious	quite serious	extremely serious
fire-fight or move to fire	161	223	76
all other categories	484	882	365

The trend in this case is significant at the O.OO1 level (χ^2 = 10.385 1 d.f.).
Thus a decreasing proportion of people fight the fire as a first action the more serious they consider it to be.

Our overall hypothesis that flight/fight reactions will increase with increasing seriousness rating must therefore be rejected. Fire-fighting is clearly not as attractive a means of threat reduction as removing oneself from the vicinity of the fire.

Table 11 - Seriousness by First Action

First Action	Seriousness Rating		
	Not at all (%)	Quite (%)	Extremely (%)
Investigate	16	11	10
Contact Fire Brigade	9	11	10
Move away fire	2	2	3
Move towards fire	6	6	5
Warn others	6	8	12
Move towards exit	1	1	3
Leave building	7	8	10
Fire fighting	18	14	12
Minimise risk	5	2	2
Save effects	0	1	2
Raise alarm	2	3	3
Organise evacuation	1	2	2
Request help	2	2	3
Give help	2	2	1
Await rescue	0	0	0
Maximise risk	1	1	0
Attempt rescue	0	0	1
Return in	0	0	0
Switch off mains	5	4	3
Contact authority	3	2	0
Shut doors	1	4	3
Evacuate family	2	6	8
Move burning object	1	1	1
Get dressed	1	3	2
Assist Fire Brigade	0	0	0
Enquire if Fire Brigade contacted	1	4	4
Move to safe place	1	1	0
Cover face with cloth	0	0	1
Inaction	5	1	0

Other interesting points arising from Table 11 are :

(a) the significant trend for an increasing proportion of people to evacuate their family, the more serious they consider the fire.
(χ^2 = 14.66 1 d.f. signif at 0.001 level)

(b) the significant trend for an increasing proportion of people to warn others, the more serious they consider the fire.
(χ^2 = 10.23 1 d.f. signif at 0.001 level)

(3) First Action/Familiarity with building

Familiarity with the building would seem, on a common sense basis, to be a possible key variable in determining people's first actions in fire. We would expect it to have its largest effect upon whether or not a person chooses to immediately leave the building. We may predict the direction of this change in either of two ways :

(a) the more familiar a person is with a building, the more likely he will leave immediately due to his superior knowledge of escape routes.

(b) the less familiar a person is with a building, the more likely he will leave immediately due to feeling more threatened.

We have seen that only 15% of the interviewees were less than completely familiar with the building, the lower two categories of our four point scale containing too few respondents to permit statistical analysis. If we compress our four point scale into two categories, "completely familiar with the building" and "less than completely familiar with the building", we may attempt to test our hypotheses. The contingency table is appended.

	less than completely familiar	completely familiar
move towards exit or leave	41	170
all other categories	289	1690

The proportions are such as to support hypothesis (b) but this is not significant (χ^2 = 3.466, 1 d.f.), so we must conclude that familiarity with the building does not affect whether or not a person immediately leaves the building.

The complete breakdown of First Action by Familiarity is not tabulated here due to small numbers rendering percentage calculations invalid. However examining the categories on a post-hoc basis reveals the following points

(1) a significantly greater proportion of these "less than completely familiar with the building" who are "inactive" (χ^2 = 20.750, 1 d.f., significant at 0.001 level)

Table 12 - Training by First Action

First Action	Training Frequency			
	Never (%)	Once Year (%)	Once 6 mths (%)	Every Month (%)
Investigate	12	17	13	10
Contact Fire Brigade	10	13	8	12
Move away fire	2	1	3	0
Move towards fire	5	4	11	7
Warn others	8	8	6	6
Move towards exit	2	1	4	0
Leave building	8	11	6	1
Fire-fighting	15	16	17	15
Minimise risk	3	5	3	6
Save effects	1	2	0	1
Raise alarm	1	6	9	9
Organise evacuation	1	1	5	6
Request help	3	0	3	0
Give help	2	1	1	4
Await rescue	0	0	0	0
Maximise risk	1	1	0	0
Attempt rescue	0	0	0	0
Return in	0	0	0	0
Switch off mains	5	3	1	3
Contact authority	2	4	4	2
Shut doors	3	2	1	2
Evacuate family		3	1	2
Move burning object	2	0	0	1
Get dressed	3	0	3	1
Assist Fire Brigade	0	0	0	0
Enquire if Fire Brigade contacted	3	4	2	2
Move to safe place	1	1	1	2
Cover face with cloth	0	0	0	0
Inaction	2	0	0	8

(2) a significantly greater proportion of the "less than completely familiar" group who attempt to "save personal effects" (χ^2 =7.28, 1 d.f. significantly at 0.01 level)

(4) First Action/Frequency of Instruction or Training

As with familiarity, one would intuitively consider this variable to be of possible key importance. We would expect that the more frequently a person was 'trained' or instructed concerning what actions to take in case of fire, the more likely they would make "appropriate" actions, such as contacting the Fire Brigade, warning others, fire-fighting, things to minimise risk, organising evacuation. However, inspection of Table 12 reveals few discernible trends in these categories. Only in "raise Alarm" and "organise evacuation" is there a consistent increase in proportions of people doing these actions with increased training frequency. In both of these the increases are significant at the 0.001 level. In all other categories however there is no significant difference. Thus apart from the two above mentioned action categories, training appears to have remarkable little effect upon first actions taken.

(5) First Action/Building Category

Our previous categorisation of buildings into 20 different occupancies is too fine a discrimination when sorted by 29 possible first actions. Categories were therefore combined as shown in Table 13. The categories not only indicate the physical type of building but also in a general sense the type of environment they represent. For example the first three categories may be considered as "home", the next two as "work", the next as "institutional", and the next as "retail". Percentages are omitted from the final column due to small numbers. Due to the generalised nature of the variable, a priori hypotheses were not developed, so any relationships which emerged in examining Table 13 were only accepted if they attained the 0.01 level of significance.

On inspection the most striking points are:

(a) the relatively large proportion of people who contacted the Fire Brigade in the 'retail' group (significantly greater than all the other groups)

(b) the relatively large proportion of people who 'warn others' in the 'home' environment, especially multi-occupancy dwellings. (significantly greater than all other groups).

(c) the fact that the proportion of people who left the building immediately was not significantly affected by the category of building.

(d) the increased proportion of people who "fought the fire" in the work and retail groups compared to home and institutional (significant beyond 0.001 level).

Table 13 - Building by First Action

	Building Category							
	'Home'			'Work'		Instit utional	'Retail'	Other
	Dwelling	Flats	Multi occup ancy	Factory	Ware house Garage	Hospital School College Hostel Hotel	Shops Pub Cafe	Other Office
First Action	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Investigate	12	12	17	12	8	15	10	
Contact Fire Brigade	9	12	12	7	13	7	16	
Move away fire	2	3	3	1	1	3	2	
Move towards fire	5	4	8	7	11	7	1	
Warn others	8	9	20	6	4	7	6	
Move towards exit	1	3	3	1	2	1	2	
Leave building	8	6	6	7	17	7	8	
Fire-fighting	10	12	6	23	14	12	20	
Minimise risk	1	0	0	9	2	2	2	
Save effects	0	0	3	1	4	3	2	
Raise alarm	0	0	1	7	3		1	
Organise evacuation	1	3	0	1	3	5	3	
Request help	3	1	1	2	2	1	3	
Give help	1	1	3	2	1	2	2	
Await rescue	0	0	0	0	0	0	0	
Maximise risk	1	1	1	0	0	0	0	
Attempt rescue	0	0	1	0	0	0	0	
Return in	0	0	0	0	0	0	0	
Switch off mains	6	4	2	1	1	2	8	
Contact authority	1	1	0	4	5	4	3	
Shut doors	6	3	3	0	0	2	1	
Evacuate family	11	10	2	0	1	1	1	
Move burning object	2	2	1	0	1	2	0	
Get dressed	3	4	4	1	1	3	0	
Assist Fire Brigade	0	0	0	0	0	0	0	
Enquire if F.B. contacted	3	3	2	2	1	0	4	
Move to safe place	0	2	1	1	1	1	1	
Cover face with cloth	0	0	0	0	0	2	0	
Inaction	1	1	1	4	5	5	2	

(6) First Action/Presence of recognised escape routes

Other than to predict that people are more likely to leave when recognised escape routes are present it is difficult to previously assess the possible effects of this variable. Inspection of Table 14 shows indeed that the proportions of people immediately leaving are in fact the reverse of our prediction. That is, people are more likely to immediately leave the building when recognised escape routes are absent. (χ^2 = 11.25, 1 d.f. signif. at 0.001 level). The other points which emerge are, that where recognised escape routes are present;

(a) a significantly greater proportion of people will immediately contact the Fire Brigade. (χ^2 = 18.63, 1 d.f. signif. at 0.001 level), and

(b) a significantly greater proportion of people will immediately fight the fire. (χ^2 = 8.39, 1 d.f., signif. at 0.01 level).

(7) First Action/Presence of Smoke

It would be hypothesised that the presence of smoke represents a more threatening situation than its absence. Consequently we would expect more people to both leave the building immediately and fight the fire under smoke present conditions. Examining Table 15 (a) however, show that although there is a slightly greater percentage of people who fought the fire under 'smoke present' (not significant however) amazingly a much greater percentage of people immediately leave the building when there is no smoke'. (χ^2 = 22.25 1 d.f., signif. at 0.001 level).

It is difficult to explain this finding unless we hypothesise that when smoke was present it was sufficiently extensive to prevent people leaving immediately.

In contrast we note that a significantly greater percentage of people evacuate their families when smoke is present which would be predicted on the basis of smoke constituting more threat.

(8) First Action/Extent of Smoke Spread

In terms of threat to life, the extent of smoke spread is one measure of how serious the fire is. Again a simple hypothesis would be that increased smoke spread would be related to increased threat behaviour. Examination of Table 15 (b) shows that the only consistent trent is for more people to evacuate their families as smoke spreads increase. In the case of our other two categories of interest, immediate evacuation and fire-fighting, for the former we see an increase in evacuation behaviour, up to the point where smoke spread is more extensive than the floor immediately above the scene of the incident, when presumably smoke becomes a physical barrier to immediate evacuation. The percentage of people fire-fighting however,

Table 14 - Escape Routes by First Action

First Action	Recognised Escape Routes	
	Present (%)	Absent (%)
Investigate	13	12
Contact Fire Brigade	16	9
Move away fire	2	2
Move towards fire	3	6
Warn others	5	9
Move towards exit	0	2
Leave building	4	9
Fire-fighting	19	14
Minimise risk	3	3
Save effects	0	1
Raise alarm	7	2
Organise evacuation	3	2
Request help	3	2
Give help	1	2
Await rescue	0	0
Maximise risk	0	1
Attempt rescue	0	0
Return in	0	0
Switch off mains	5	4
Contact authority	4	2
Shut doors	2	3
Evacuate family	4	6
Move burning object	2	1
Get dressed	0	3
Assist Fire Brigade	0	0
Enquire if Fire Brigade contacted	3	3
Move to safe place	1	1
Cover face with cloth	0	0
Inaction	1	3

Table 15

First Action	(a) Presence of Smoke: Present (%)	(a) Presence of Smoke: Absent (%)	(b) Smoke Spread: None (%)	(b) Smoke Spread: Confined to room (%)	(b) Smoke Spread: Confined to floor (%)	(b) Smoke Spread: Floor above (%)	(b) Smoke Spread: More Extensive (%)
Investigate	12	11	11	12	13	15	10
Contact Fire Brigade	10	10	11	10	12	9	10
Move away from fire	2	1	1	2	2	2	4
Move towards fire	6	4	7	6	8	3	4
Warn others	8	5	7	6	8	12	14
Move towards exit	2	0	0	1	2	3	3
Leave building	7	15	5	7	8	8	6
Fire-fighting	15	13	17	17	16	13	13
Minimise risk	3	4	5	4	2	3	2
Save effects	1	2	0	1	1	0	4
Raise alarm	2	6	4	3	2	2	1
Organise evacuation	2	1	0	2	2	2	1
Request help	2	3	0	2	4	2	1
Give help	2	2	3	2	2	2	1
Await rescue	0	0	0	0	0	0	0
Maximise risk	1	0	1	1	1	1	1
Attempt rescue	0	0	0	0	0	0	1
Return in	0	0	0	0	0	0	1
Switch off mains	4	3	11	5	3	1	2
Contact authority	2	4	5	2	1	2	0
Shut doors	3	1	0	4	3	5	2
Evacuate family	6	1	2	5	6	7	8
Move burning object	1	0	0	2	1	1	1
Get dressed	2	3	3	1	2	4	6
Assist Fire Brigade	0	0	0	0	0	0	0
Enquire if FB contacted	3	3	5	3	2	3	3
Move to safe place	0	2	0	1	0	0	2
Cover face with cloth	0	0	0	0	0	0	2
Inaction	2	5	2	4	1	1	0

becomes less as the smoke spread increases, which might suggest that people recognise the threat to life which smoke represents and do not persist in fire-fighting when this threat increases and their chance of leaving the building decreases.

(9) First Action/Presence of Other People

Examination of an individuals behaviour would be meaningless if done without taking into account the presence and relationship of others around him. Few would argue that such factors would have a substantial effect upon behaviour. For instance it seems clear that any fire which occurs in a building where young children are present, should be considered more "threatening" than one where they are not. Consequently one would predict an increased likelihood of immediate evacuation in such cases. Examination of Table 16 shows in fact that this is so in the case of "evacuate family", category which is substantially larger when children under 12 are present than when there are other family members. It is nonetheless a sobering thought that in 5% of the cases when children under 12 were present, people left the building immediately, i.e. without their children.

The proportion of people who fight the fire increases as we move across the table except in the sole case of the 'parents' group. Neither result is unexpected since we have already seen that people in work environs are more likely to fight the fire, and they will be strongly represented in the last three columns. It is likely that the responses in the parents group are largely from young children who were interviewed, this contention being supported by the large percentage of this group who warn others, i.e. their parents as a first reaction.

Other points arising from the study of Table 16 are;

(a) the popularity of "Shutting doors" as a first action being restricted to cases where immediate family members are present.

(b) the fact that the "maximise risk" category, i.e. doing something completely inappropriate, only occurs in cases where children are present.

(c) the relatively greater proportion of people who "save effects" in the 'wife or husband' group.

(10) First Action/Previous involvement

We might expect that being previously involved in a fire incident would act as a sort of training. At the least one might think that it would remove some of the immediate shock of the fire. One could therefore predict that people who had been previously involved would be more likely to behave "appropriately" in such things as immediately contacting the Fire Brigade, warning other people, possibly firefighting and perhaps show less inclination to immediately leave the building. Table 17 (a) shows that this is only partially true.

Table 16 - Presence of Others by First Action.

First Action	Presence of Other People							
	under 12 (%)	over 12 (%)	wife/ husband (%)	your parents (%)	other relations (%)	friends (%)	acquaintances (%)	people unknown (%)
Investigate	10	14	18	12	12	13	13	16
Contact Fire Brigade	10	12	9	4	9	11	7	14
Move away fire	2	0	1	6	2	2	1	0
Move towards fire	2	4	7	7	8	6	8	3
Warn others	8	10	11	22	7	9	6	3
Move towards exit	1	2	1	4	1	2	1	3
Leave building	5	6	7	12	14	7	10	7
Fire-fighting	9	10	12	6	15	16	20	19
Minimise risk	0	1	0	3	1	4	6	0
Save effects	0	0	3	0	0	1	1	2
Raise alarm	1	1	0	0	0	5	5	5
Organise evacuation	2	2	1	1	1	3	1	2
Request help	2	1	1	1	7	1	2	2
Give help	1	2	3	2	1	2	1	7
Await rescue	0	0	0	0	0	0	0	0
Maximise risk	1	2	0	0	0	0	0	0
Attempt rescue	1	0	0	0	0	0	0	0
Return in	0	0	0	0	0	0	0	0
Switch off mains	6	5	6	4	4	2	2	5
Contact authority	1	1	0	0	1	3	4	5
Shut doors	6	9	5	1	1	1	1	0
Evacuate family	26	5	1	2	7	0	0	0
Move burning object	2	0	2	2	1	0	1	0
Get dressed	2	1	4	10	2	2	1	0
Assist Fire Brigade	0	0	0	0	0	0	0	0
Enquire if F.B. contacted	2	9	5	1	4	2	3	3
Move to safe place	1	1	1	1	0	0	1	0
Cover face with cloth	0	0	0	0	1	0	0	0
Inaction	0	1	1	1	1	5	3	3

Table 17

First Action	(a) Previously Involved: Yes (%)	(a) Previously Involved: No (%)	(b) Sex: Men (%)	(b) Sex: Women (%)
Investigate	14	11	13	11
Contact FB	10	10	10	11
Move away from fire	1	2	1	3
Move towards fire	8	5	8	3
Warn others	5	9	6	10
Move towards exit	1	6	1	2
Leave building	6	9	7	9
Fire-fighting	19	13	20	8
Minimise risk	6	2	4	2
Save effects	1	1	1	2
Raise alarm	5	2	4	1
Organise evacuation	2	2	2	2
Request help	2	2	1	4
Give help	2	2	1	2
Await rescue	0	0	0	0
Maximise risk	1	1	1	1
Attempt rescue	0	0	0	0
Return in	0	0	0	0
Switch-off mains	4	4	3	5
Contact Authority	3	2	2	2
Shut doors	2	4	3	4
Evacuate family	2	7	3	9
Move burning object	1	1	1	1
Get dressed	2	2	2	3
Assist FB	0	0	0	0
Enquire if F.B. contacted	2	3	3	2
Move to safe place	1	1	0	1
Cover face with cloth	0	0	0	0
Inaction	1	2	2	2

The percentage of people immediately contacting the Fire Brigade is independent of previous involvement.

Significantly more people who have not been previously involved 'warn others', although in 'raising the alarm' this is reversed. (It should be pointed out that in coding the questionaire, a distinction was drawn between warning or alerting people individually and raising some sort of general alarm by shouting, etc.)

Significantly more of those who had been previously involved fought the fire, and did something to minimise the risk, while significantly less immediately left the building.

(11) First Action/Sex

The question of sex difference in behaviour is somewhat vexed. Earlier cited work suggests that women are no more likely to exhibit a 'panic type' response than men.

Where men are present however we would think that women are less likely to fight the fire and more likely to be concerned with evacuation of the family. Both these hypotheses are supported by analysis of Table 17 (b).

The differences which emerges are that women are significantly more likely to;

(a) warn others
(b) immediately leave the building
(c) request assistance
(d) evacuate their family

and significantly less likely to;

(a) fight the fire
(b) minimise the risks

If we rank order the actions by frequency for male and female it is then possible to examine the correlation between them. Using Spearman's 'rho' we obtain a correlation of 0.617 between the ranked male and female actions, which is significant beyond the 0.01 level

(12) First Action/Age

We would expect the most important effects of age to be demonstrated at the extreme ends of the scale, i.e. the very young and very old.

The numbers in these categories 0 to 9 and 70 to 99 years have been combined. The data is illustrated in Table 18. Some rather surprising trends emerge. For instance, the increasing proportion of people who fight the fire from 10 to 59 years.

Table 18 - First Action by Age

First Action	Age in years						
	10-19 %	20-29 %	30-39 %	40-49 %	50-59 %	60-69 %	70-99 + 0-9 %
Investigate	13	14	11	11	13	14	9
Contact FB	7	10	12	12	9	6	8
Move away from fire	5	1	1	0	2	2	5
Move towards fire	6	5	5	5	8	7	4
Warn others	13	8	7	10	6	6	10
Move towards exit	3	2	1	2	1	2	4
Leave building	15	11	6	7	4	6	3
Fire-fighting	10	14	14	18	20	9	9
Minimise risk	3	1	4	3	4	4	0
Save effects	1	1	0	1	3	1	1
Raise alarm	2	4	3	3	2	1	0
Organise evacuation	1	2	2	2	0	1	1
Request help	4	1	3	2	1	4	6
Give help	1	1	2	3	1	3	3
Await rescue	0	0	0	0	0	0	0
Maximise risk	0	0	0	1	1	3	1
Attempt rescue	0	0	0	0	0	0	0
Return in	0	0	0	0	0	0	0
Switch-off mains	1	3	5	3	8	6	5
Contact authority	2	2	1	3	3	2	0
Shut doors	1	3	4	3	1	7	3
Evacuate family	3	8	9	3	1	3	1
Move burning object	1	1	2	1	1	3	3
Get dressed	4	2	1	2	2	3	10
Assist FB	0	0	0	0	0	0	0
Enquire if FB contacted	0	2	3	3	4	3	4
Move to safe place	0	1	1	0	1	1	1
Cover face with cloth	0	0	0	0	0	1	1
Inaction	2	3	2	1	2	2	6

Clearly after this age the likelihood of fire-fighting decreases sharply, although a surprising number still does. In the same way there is a not completely consistent trend for the proportion of those immediately leaving to decrease with increasing age.

In other respects the table reflects remarkably little effect of age upon behaviour. The high percentage of those aged 20 to 39 who evacuate their families clearly reflects the presence of young children in that population. Similarly the 'passive' behaviour of the very young and very old is illustrated by the percentage of those who 'request help' or come into the 'inaction' category.

Having examined how some of the variables affect overall behaviour in the fire, we now look at the way in which they affect our two selected behavioural variables, evacuation of the building and movement through smoke.

Evacuation of the Building

(1) Whether or not left the building/Sex

Earlier analysis show that women are significantly more likely to immediately leave the building. The question being asked now is whether this difference is consistent over the course of the incident. Our hypothesis would be that it is. The contingency table below shows the frequencies.

	men	women
leave building	605	583
not leave	634	369

This yields a χ^2 value of 32.95, ldf which is significant beyond 0.0001.

Thus overall, women are more likely to leave the building than men.

(2) Whether or not left the building/whether knew of escape route

The obvious hypothesis is that people are more likely to leave the building if they say they know a means of escape. The contingency table shows however that the proportions indicate the opposite.

	leave building	NOT leave
know means of escape	708	695
NOT know means of escape	480	295

The χ^2 value is 26.50, significant beyond the 0.001 level.

Thus people are more likely to leave the building if they don't know any means of emergency escape.

A possible explanation which one may offer to explain this strange result is that perhaps the people who know a means of emergency escape feel less threatened by the fire, and more prepared to take other actions, secure in the knowledge that they may leave using the emergency escape route.

(3) Whether or not left the building/Presence of smoke

Since the presence of smoke increases the threat, our hypothesis is that a greater proportion of people will leave under 'smoke present' conditions.

	leave the building	NOT leave
Smoke present	1057	846
Smoke absent	129	140

χ^2 value is 5.48, significant at the 0.02 level.

Thus our hypothesis is supported, people are more likely to leave the building when smoke is present.

This is in contrast to our findings when examining "First Action". It would seem that when there is no smoke a greater proportion of people tend to leave the building immediately, whereas when smoke is present people tend to do other actions before leaving. Ultimately, as we have seen a greater proportion of people left when smoke was present.

(4) Whether or not left the building/Previous involvement

Our earlier analysis demonstrates that significantly less people who have been previously involved immediately leave the building. We hypothesise that this remains true throughout the course of the incident.

	leave the building	NOT leave
Previously involved	269	377
NOT Previously involved	914	607

χ^2 = 62.27 significant beyond 0.001 level. The hypothesis is supported, people are less likely to leave the building if they have been previously involved in a fire incident.

(5) Whether or not left building/Age

As mentioned earlier, perhaps the two most interesting classes, the very young and very old, contain very few respondents, making statistical treatment of this data difficult. We would hypothesise that the proportion of the very young leaving (or being evacuated) from the building would be very high. A similiar prediction for the very old must be tempered by the considerations of physical infirmity. Figure 8 illustrates the proportion of people leaving by age. It will be noted that the age range 0-9 has in fact by far the highest percentage, however this is not statistically significant due to the aforementioned small numbers. There also appears to be a consistent decrease in the percentage of people leaving up to the age range 60-69, however again this trend is not significant. The sharp rise from 60 to 79 and the subsequent fall in the 80-89 age range are also of interest. One might interpret this by suggesting that people between 60 and 79 are old enough to be readily frightened into leaving, whilst those older are too infirm to do so.

(6) Whether or not left building/Familiarity with building

There are two attractive hypotheses which suggest themselves with respect to this variable. Firstly that the more unfamiliar people are with the building the more likely they will leave due to feeling more threatened. Secondly that increased familiarity will be associated with greater frequency of leaving due to increased awareness of all the possible exits.

In fact, overall there is no significant relationship between whether or not people left the building and their familiarity with it, so both the above hypotheses must be rejected.

(7) Whether or not left building/Frequency of training

Hypotheses concerning training are difficult to formulate without knowledge of what form the training takes. For instance, although we might consider leaving the building as a sign of abandonment of ones responsibilities, it may well be that any training is simply directed towards getting people to leave the building. Indeed most fire-drills take this simple form. Our scaling of 'training' was necessarily crude due to space restrictions on the questionnaire, and in this light one might consider it to be more akin to a dichotomous division, i.e. "no training" and "some training". Our hypothesis is that these two groups behave differently with respect to leaving the building but we are unable to predict in what way due to the factor mentioned above.

In addition it might be argued that people who are trained very frequently, i.e. "more often than once per month" represent a group whose awareness of fire is of a different order to that of our other categories and thus themselves constitute a separate group. We might then examine the dichotomy between "at least once per month" and "all others". It is likely that this

Figure 8

% people leaving building by age.

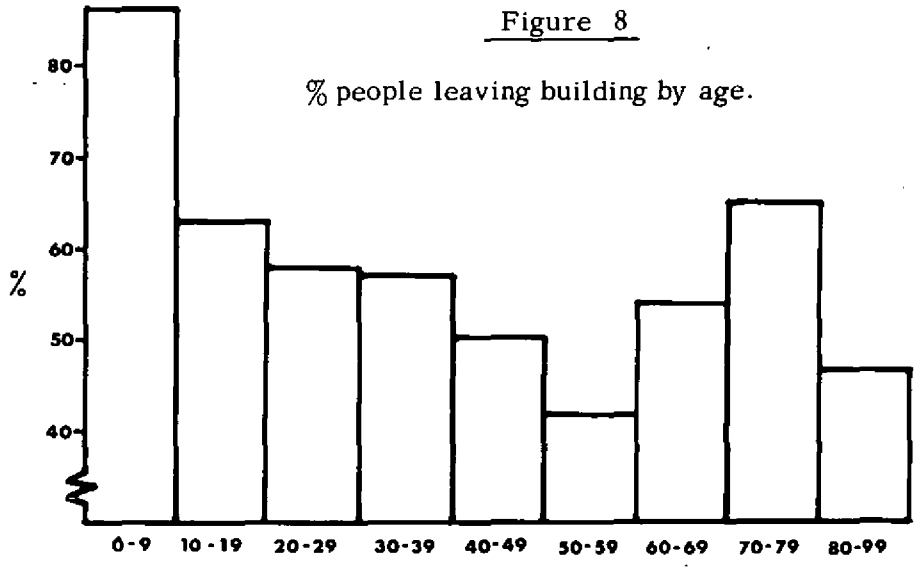


Figure 9

% people leaving by smoke spread.

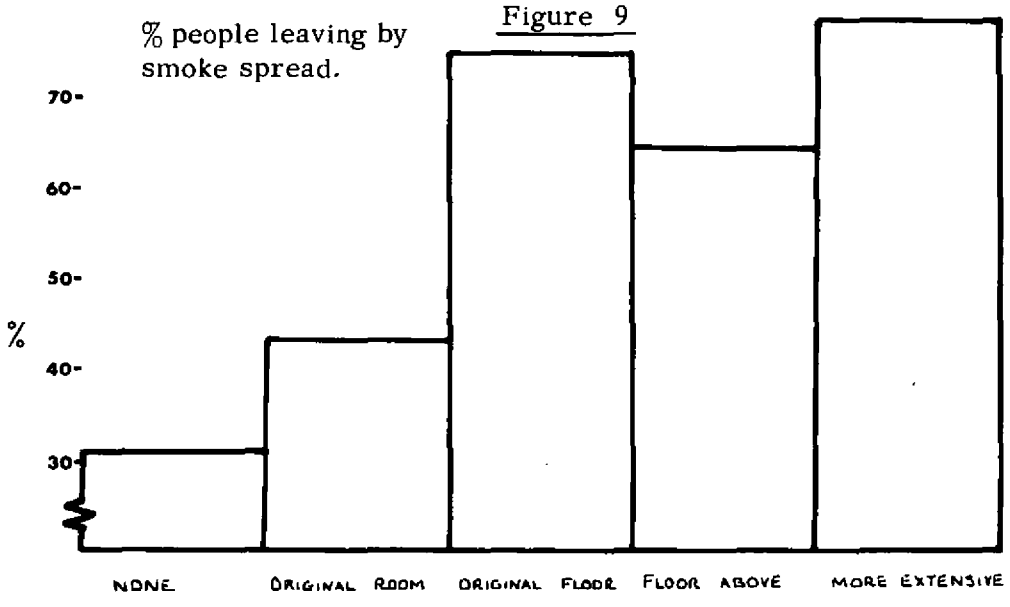
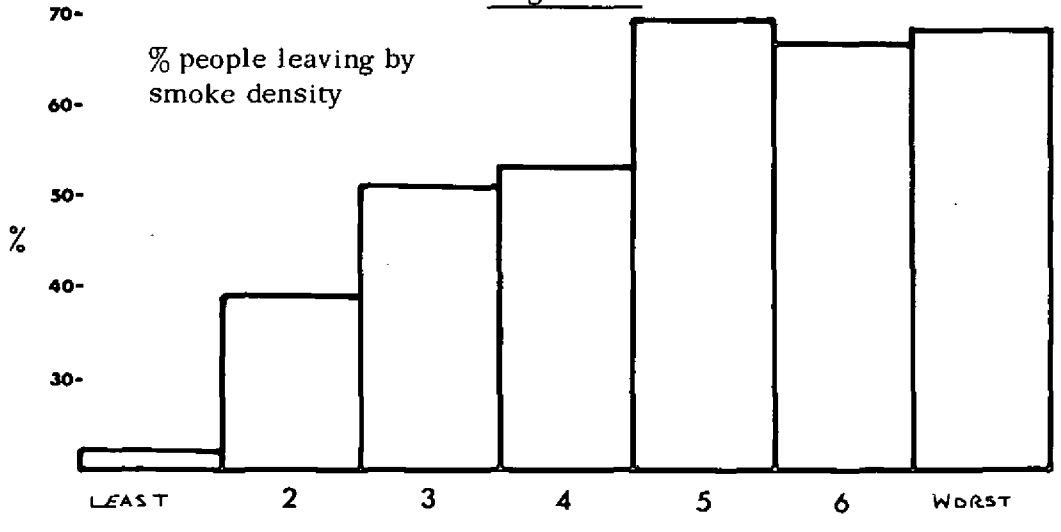


Figure 10

% people leaving by smoke density



"frequent training" group are trained beyond the simple 'evacuation of the building' type fire-drill and are probably assigned other tasks such as raising the alarm or fire-fighting. In which case we predict that they leave less frequently than our other groups.

Partitioning the contingency table in such as to test these hypotheses we find that;

(a) a significantly greater proportion of people with no training leave the building compared to those with some training.

(b) a significantly smaller proportion of those who are trained at least once per month leave the building compared to all other groups.

Both our hypotheses are thus supported.

(8) Whether or not left the building/Time of incident

A fire occurring during the night must be considered more threatening than at other times, and we would hypothesise that people are more likely to leave the building in these circumstances.

Testing this hypothesis however yields a non-significant χ^2. Thus we must accept the null hypothesis that people are no more likely to leave the building during the night than they are during the day.

(9) Whether or not left building/Position of fire relative to person

Again we may make two predictions concerning this variable. The more threatening situation must be where the fire is below the person, on which basis one would predict that a greater proportion of people would leave. Conversely, the effects of the fire will make it physically more difficult to leave when the fire is below the person, leading to a prediction in the opposite direction. Partitioning the contingency table to test this hypothesis yields a non significant χ^2, although the χ^2 over all the groups is significant. Thus we must reject our original hypotheses, and all we may say is that there is a significant difference between those who leave and do not leave with respect to their position relative to the fire, but it is not possible to say how this relationship works.

(10) Whether or not left building/Extent of Smoke Spread

Smoke spread is also a variable which, whilst increasing the threat level may also act to prevent evacuation of the building. However it should be remembered that this variable is a fireman's estimate, and therefore a measure of the ultimate extent of smoke spread, not necessarily that which obtained during the initial stages of the incident. Since extensive smoke spread will also alert more people to the fire we would favour the hypothesis that increased levels of smoke spread are associated with proportionately more frequent evacuation of the

building. In fact inspection of Figure 9 shows that although there is evidence of a trend, this is not completely consistent. What is obvious is the large discrepancy between the first two categories and the subsequent three. Treating these as dichotomous and remembering the post-hoc nature of this treatment we find that the partitioned χ^2 is highly significant. We thus conclude that people are more likely to leave if the smoke spreads beyond the room of origin.

(11) Whether or not left building/Smoke Density

Our estimates for smoke density are also Fire Brigade based, and also related to previous experience of the member of the brigade involved. In this case we would expect that upper reaches of the scale are beyond normal experience for lay people. As in smoke spread we may construct two hypotheses, increased smoke density being associated with increased threat level and thus increased evacuation behaviour, or alternatively, increased smoke density may present sufficient physical barrier to decrease the proportions of those leaving. Treating the data statistically reveals a highly significant trend for increased smoke density to be associated with increased proportions of people leaving. It would seem that the increased threat associated with high levels of smoke density outweighs the possible difficulties experienced in moving in these conditions. Figure 10 shows a graphical presentation of the data and it is interesting that above '5' on the scale the percentage of people leaving are not substantially different from each other, which lends support to our earlier point concerning the 'shifting' of the scale values upwards due to the scale being Fire Brigade related. Clearly position '5' on a Fire Brigade scale is equivalent to the "worst" position for lay people.

(12) Whether or not left building/Seriousness rating of fire

Throughout all these analyses we have hypothesised that increased threat level will be associated with increased evacuation behaviour. As pointed out earlier, the rating of the fire on a "seriousness" scale provides us hopefully with some measure of the subjective level of threat. We would therefore predict that people are more likely to leave the building the more serious they consider the fire. In fact analysis shows that there is not a consistent trend in this direction but that there is a significant difference between two categories, those who consider the fire 'extremely serious' and those who consider it 'less than extremely serious'. Partitioning the χ^2 in this way shows a highly significant result. We may therefore state that people who consider the fire extremely serious are more likely to leave the building than those who consider it less than extremely serious.

We will now briefly examine the effects of certain variables upon which exits were used in leaving the building.

(1) Which exit used/Knowledge of means of emergency escape

We would expect that people who stated they knew a means of emergency escape would be more likely to use an emergency exit. Partitioning the data in this way yields χ^2 value significant beyond the 0.001 level. The above hypothesis is therefore supported.

(2) Which exit used/Position of fire relative to person

Unfortunately our seven category scale of position of fire relative to the person, when cross-tabulated with exit used, gives very small values in many cells thus making overall analysis difficult. Combining our fire position categories to alleviate this difficulty, we may test between two groups, fire on same floor or below against fire above the person. This analysis yields a non-significant result, and we therefore conclude that position of the fire relative to the person does not affect which exit he used.

(3) Which exit used/Presence of smoke

We would predict that people would be more likely to use exits other than normal when smoke was present. However analysis yields a non-significant result. We therefore reject the above hypothesis and conclude that the presence or absence of smoke does not affect which exit is used.

(4) Which exit used/Familiarity with the building

We would expect a greater variety of exits to be used if people are completely familiar with the building. Again analysis shows that there is no significant difference between exits used and the person's familiarity with the building. We reject the above hypothesis.

(5) Which exit used/Extent of smoke spread

Since extensive smoke spread should act to prevent people using their normal exits, we would expect an increased frequency of use of exits other than normal. Analysis of the data confirms this. The more extensive the smoke spread the more frequently exits other than normal ones were used.

Return into Building

Having examined some factors which affect whether or not people leave the building and the exits they used we now turn our attention to variables which may be related to whether or not people return into the building during the course of the fire.

(1) Whether or not return into building/Sex

Having seen that women are more likely to leave the building, on the basis that they are

unlikely to put themselves back into the stressful environment of the fire we would predict that they would return less frequently than men. In addition it would seem likely that men who leave the building are more likely to feel that simply absenting themselves from the scene of the fire reflects badly upon their 'manhood'. They may then be constrained by this and other pressures to return into the building and be 'active". The contingency table below illustrates the proportions.

	Return into building	NOT return in
men	321	284
women	201	382

This yields a ^{2} value of 41.65, ldf which is significant beyond the 0.001 level. We thus accept the hypothesis that men are more likely to return into the building than women.

(2) Whether or not return into building/Age

As before we are somewhat limited in our ability to analyse what are potentially the most interesting groups by too small numbers in these categories. We would predict that these groups would return in substantially less frequently than other age groups. Furthermore as a general hypothesis we would predict that, apart from the very young there would be a decreasing trend to return in with increasing age.

Combining 'very young' and 'very old' in our analysis, we find no significant difference between this age group and others. Furthermore, overall there is no significant relationship between age and returning in. Examining the proportions on a post-hoc basis we find that the age range 20 to 39 years appears to contain the largest proportion of people who return in. Partitioning the contingency table in this way (and remembering that post-hoc hypotheses are only accepted if they achieve the 0.01 level significance), yields a χ^2 of 8.696, ldf which is significant beyond 0.01. We may therefore conclude that people between 20 and 39 years of age were more likely to return into the building. In retrospect it is not difficult to interpret this finding, since people between these ages are at their most active.

(3) Whether or not return into building/Presence of smoke

We would predict that people would be less likely to return into the building when smoke was present. The contingency table however shows the proportions to be the reverse of this.

	Return into building	NOT return in
Smoke present	479	607
Smoke absent	42	92

This yields a χ^2 value of 7.94 (ldf) which is significant beyond 0.01 level. Thus people were more likely to return into the building when smoke was present. This result provides an an insight into the ignorance of people in general as to the effects and dangers of smoke. It is clear that where more than 20% of our sample are prepared to make such an injudicious action there must be a considerable scope for education in this matter.

(4) Whether or not return into building/Previous involvement

On a general thesis we might expect people who have been previously involved in a fire to behave more "appropriately" than those who have not. In which case we would predict that they would be less likely to return in. Again, examination of the cont ingency table shows the reverse of this to be true.

	Return into building	NOT return in
Previously involved	133	136
NOT Previously involved	386	528

The χ^2 value is 4.39 (ldf), significant beyond the 0.05 level. People who had been previously involved in a fire incident were more likely to return into the building.

If returning into a building during the course of a fire may be considered "inappropriate" behaviour, then previous involvement would seem to increase its likelihood.

(5) Whether or not return into building/Training frequency

If we accept that in general returning in is not a good thing then we would expect increased training frequency to be associated with less frequent returning in. In an earlier analysis we postulated that our scale of training frequency should be considered as two dichotomous groups, some training against none, and very frequent training i.e. at least once per month, against less frequent or none.

Treating the data in this way we find that firstly there is an overall significant difference between the training frequencies and the proportions of people returning in (χ^2 = 8.044, 3 d.f., significant at 0.05 level). However there is no evidence of a trend in the results. Partitioning the χ^2 to obtain our two dichotomous groups produces non-significant differences in each case. We therefore reject our hypothesis that people are less likely to return into the building the more frequently they are trained.

(6) Whether or not return into building/Familiarity with building

Our hypothesis in this case is that increased familiarity with the building will be associated with increased tendency to return into it. Statistical treatment shows that there is a significant trend in this direction. We therefore conclude that the more familiar a person was with the building, the more likely that he would return into it.

(7) Whether or not return into building/Presence of other people

The presence of other people refers of course to other people who were present when the fire first occurred. It was unfortunately not possible to record at which stage in the incident each person left the building. Had we been able to do this then our hypothesis would have been much more clear cut. It would be much more likely that people would return into a house if they knew that children, or close family members were still in it. Examining the data shows that even without the additional information mentioned above, there is still a significant difference between close family members and others. Where such people (children, wife/husband or parent) are present, a significantly greater proportion of people are prepared to return into the building.

(8) Whether or not return into building/Building category

On the basis that people who are in their 'home' environment might, when they have left the building, be reluctant to stand about and watch all their possessions be destroyed, we would predict that they would be more likely to return into the building than people in other occupancies. Testing for an overall difference yields a non-significant χ^2 value and testing the above hypothesis also gives a non-significant value. We must therefore reject the above hypothesis and conclude that the proportion of people returning into the building is not affected by the category of the building.

We now turn to consideration of factors which affect whether or not a person moves through smoke and how far he moves through it.

MOVEMENT THROUGH SMOKE

(1) Whether or not moved through smoke/sex

On the hypothesis that men are likely to be more 'active' than women, we would predict that they were more likely to move through smoke than women. The contingency table below shows this to be true.

	Move through smoke	NOT move through smoke
Men	684	380
Women	448	388

This gives a χ^2 value of 22.25 (1df), which is significant beyond the 0.001 level. The hypothesis that men are more likely to move through smoke than women is supported.

(2) Whether or not moved through smoke/Age

We have seen in previous analyses that age effects are difficult to predict with accuracy. However, as above, we would expect people in the younger, more active age ranges to be more prepared to move through smoke than others. Statistical examination shows however that there is no significant difference between the ages. We must reject our hypothesis and conclude that the age of the person does not affect whether or not he moves through smoke.

(3) Whether or not moved through smoke/Seriousness rating

Two opposing hypotheses may be propounded with regard to this variable. Firstly, that since the presence of smoke increases the level of threat, then people will only move into it if they consider the situation very serious. On this hypothesis the more serious a person regards the fire, the more likely that he will move through smoke. Secondly we might consider that a person who already considers himself extremely threatened is unlikely to add to this threat by attempting to move through smoke. On this hypothesis we would predict that the more serious a person considers a fire to be the less likely that he will move through smoke.

Inspection of the data shows a consistent, and significant trend for increasing seriousness rating to be associated with increased frequency of movement through smoke. Therefore our first hypothesis is supported, the more serious a person considers the fire to be, the more likely he will move through smoke.

(4) Whether or not moved through smoke/Knowledge of escape routes

Having seen above that subjective threat level is positively associated with increased movement through smoke, we would consider that those who do not know a means of escape

would be more likely to move through smoke. The contingency table shows that there is in fact virtually no difference in proportions.

	Move through smoke	NOT move through smoke
Know escape route	719	488
Not know escape route	415	280

The χ^2 value is extremely small, yielding a non-significant result. We must reject our hypothesis and conclude that knowledge of escape routes does not affect whether or not a person moves through smoke.

(5) Whether or not moved through smoke/Previous involvement

Our hypothesis for this variable is that those who have been previously involved in a fire incident are more likely to move through smoke. However, again the contingency table shows only small differences in proportion.

	Move through smoke	Not move through smoke
Previously involved	334	209
Not previously involved	798	552

The χ^2 value is 0.93 (1df) which is not significant. We reject our hypothesis and conclude that previous involvement in a fire incident does not affect whether or not a person moves through smoke.

(6) Whether or not moved through smoke/Familiarity with the building

We may consider that this variable is an extension of (4) above and make our prediction on the basis that unfamiliarity with the building will be associated with increased threat and thus increased likelihood of movement through smoke. However it may also be argued that unfamiliarity with the building will be a potent reason for not moving through smoke. Thus two opposing hypotheses are generated.

Examination of the data shows an increasing and significant trend for movement through smoke to be associated with increased familiarity, thus lending support to our second hypothesis that the more familiar a person is with the building, the more likely that he will move through smoke.

(7) Whether or not moved through smoke/Training frequency

As previously we will consider training frequency both overall and as if it were two

dichotomous variables. Since even the most frequent training is more likely to include instruction on the dangers of smoke than on movement through it, we would predict that increased frequency of training would be associated with decreased frequency of movement through smoke.

The results of both types of analysis, for the data overall and partitioned, show no significant differences. The above hypothesis is rejected and we conclude that frequency of training does not affect whether or not a person moves through smoke.

(8) Whether or not moved through smoke/Time of incident

Again we may test how much effect the threat level affects movement through smoke. Clearly an incident occurring at night will be more threatening than one during the day. Alternately, the combined effects of smoke and darkness would be thought to mitigate against movement through smoke. Partitioning the data to examine the effects of darkness, we find that a considerable greater proportion of people are prepared to move through smoke if the incident occurs during the day than if it occurs at night. (χ^2 value 21.8, 1df. significant beyond 0.001 level). Thus the increased objective difficulty of movement through smoke at night outweighs the subjectively increased threat level. We conclude that people are more likely to move through smoke if the fire occurs during the day.

(9) Whether or not moved through smoke/Extent of smoke spread

If increased smoke spread is associated with increased threat, we would expect the proportion of people moving through smoke to increase as the smoke spreads more extensively. In contrast increased smoke spread may increase the objective difficulty of movement. Examination of the data shows in fact, that up to the point where smoke spreads more extensively than the floor above the incident, there is a significant trend for an increasing proportion of people to move through the smoke, the more extensively it spreads. In this case therefore, the threat imposed by the smoke spread is more likely to increase the proportions of people moving into smoke.

(10) Whether or not moved through smoke/Smoke density

The obvious hypothesis for this variable is that the more dense the smoke, the less likely that people will attempt to move through it. However inspection of the data shows that this simple relationship does not obtain. The proportions of people moving into smoke at various levels of smoke density are in fact significantly different, but there is no overall trend on our seven point scale of this variable. We must reject the above hypothesis and conclude that whilst smoke density does affect whether or not people move into smoke, it does so in a way which is not simply predictable.

(11) Whether or not moved through smoke/Building category

Although we would expect building category to have some overall effect upon movement through smoke, it is difficult to predict the exact nature of this effect. As before, we have combined our categories into five groups, 'home', 'work', 'institutional', 'retail' and 'other' for the analysis. Statistical testing shows that overall there is a significant difference in proportions of people moving through smoke as predicted. Examining the data on a post-hoc basis, we note that the proportions of those moving through smoke are large in the 'home' category and small in the 'work'. Partitioning the contingency table yields χ^2 values of 19.10 (ldf) for the former difference and 16.79 for the latter, both of which are significant beyond the 0.001 level. With the reservation that this is a post-hoc analysis, we would suggest that:

(a) the proportion of people moving through smoke was significantly greater in the 'home' environment than in other occupancies, and

(b) the proportion of people moving through smoke was significantly smaller in the 'work' environment than in other occupancies.

(12) Whether or not moved through smoke/Whether or not left the building

It has been suggested that since moving through smoke is a threatening and unpleasant experience, people will only move through it if they are trying to leave the building. Although we cannot test this directly, what we can do is see if the people who move through smoke are the same people who leave the building. On the above hypothesis we would expect a significantly greater proportion of those who moved through smoke to leave the building.

	Move through smoke	NOT move through smoke
Leave building	625	419
Not leave	504	342

This gives a χ^2 value of 0.02 which is not significant. We therefore reject the above hypothesis and conclude that people who moved through smoke are no more likely to leave the building than those who did not.

DISTANCE MOVED THROUGH SMOKE

(1) Distance moved through smoke/Sex

Our hypothesis is that in general, men will move further through smoke than women. Statistical examination of the data shows that as the distance moved increases, so does the proportion of men in each distance class. This trend is significant beyond the 0.001 level and therefore the above hypothesis is supported.

(2) Distance moved through smoke/Age

We would hypothesise that the 'more active' age groups, 20 to 39 years would move further through smoke. Cross tabulating our 10 age categories and 8 distance classes we find no significant difference between these age groups and others with respect to distance moved through smoke. We reject the above hypothesis and conclude that the age of the person did no affect how far he was prepared to move through smoke.

(3) Distance moved through smoke/Familiarity with the building

The hypothesis is self evident; we expect increased familiarity to be associated with increased movement through smoke. Inspection of the data shows however that there is no significant trend in this direction. We reject the above hypothesis and conclude that familiarity with the building does not affect how far a person is prepared to move through smoke.

(4) Distance moved through smoke/Training frequency

As mentioned earlier, we are somewhat constrained in our ability to erect hypotheses concerning this variable due to our lack of knowledge of what form the training takes. If it embodies techniques for easing movement through smoke, (keeping close to floor etc.) which seems unlikely, then we would expect increased frequency of training to be associated with increased movement. Alternatively, the emphasis may be on the avoidance of movement through smoke, in which case the reverse hypothesis would be made.

The data was treated as before, first as an overall scale and then partitioning it into two groups. Considering the results without partitioning we find that there is an overall significant difference between the four categories of training frequency with regard to the distances moved. Partitioning very frequent training against less frequent yields a non-significant result, whereas partitioning no training against some shows a significant trend for the proportions of those who have never received training to decrease, as distance moved increases. From this somewhat confusing result we may conclude that (a) people who had never received any training tended not to move as far through smoke as those who had, and (b) there is a significant difference between the training frequencies with regard to the distance moved through smoke, but no simple relationship exists between them.

(5) Distance moved through smoke/Presence of others

Although we may predict that this variable will affect distance moved it is difficult to suggest in which direction without more detailed knowledge of where the other people were. Statistical testing shows that there are overall significant differences between the groups. As previously, we partition the groups into close family and others, which reveals a significant trend.

As distance moved increases, the proportion of cases with close family members present decreases. We therefore conclude that people tended to move further through smoke when close family members were not present.

(6) Distance moved through smoke/Knowledge of Emergency Escape

It would be expected that people who stated they knew a means of escape would be more likely to move further through smoke. There is an overall significant difference between the two groups, i.e. between those who did and those who did not know of a means of emergency escape, but the trend is inconsistent and non-significant. However, partitioning the distance moved into two groups, up to 15 yards and more than 15 yards yields a χ^2 value significant beyond 0.001. We conclude that a significantly greater proportion of those who knew a means of escape moved more than 15 yards through smoke.

(7) Distance moved through smoke/Presence of escape route

We have seen earlier that the Fire Brigade definition of what constitutes a means of escape differs from the civilian views, since a large proportion of people say they know a means of emergency escape in buildings where the Fire Brigade judged recognised escape routes to be absent. It would seem that the presence of escape routes has little or no effect upon distance moved through smoke since statistical analysis yields a non-signficant χ^2. Partitioning distances as in the immediately previous analysis (6), also gives a non-significant result. We conclude that distance moved through smoke is independent of whether or not recognised escape routes are present.

(8) Distance moved through smoke/Distance see ahead

One would expect a close relationship between these measures. An obvious way to explore this is to examine the correlation between them. Using the Spearman correlation coefficient yields a value of 0.410. This indicates that there is a positive relationship between the distance people could see ahead and the distance they were prepared to move, but it is not consistent. Examining the data for the source of this inconsistency we find for instance that half the people who moved 10 yards through smoke stated they could only see 4 yards. Even more surprising half of those who moved 15 yards, likewise said they could only see 4 yards in front of them. These two results would appear to be the main causes of the imperfect correlation and illustrate that in some conditions people were prepared to move further through smoke than their range of visibility.

(9) Distance moved through smoke/Time of incident

Dividing the times into two groups, day and night, we would expect that people would be

prepared to move greater distances through smoke if the incident occurred during the day. Analysis shows however that the reverse of this is true. There is a significant trend for the proportion of 'night' people to increase as distance moved through smoke increases. We conclude that people involved in incidents which occur at night were likely to move further through smoke.

(10) Distance moved through smoke/Previous involvement

We have seen that previous involvement in a fire incident is not a consistent predictor of behaviour. In this case we hypothesise that people who have been previously involved will move further through smoke. Analysis shows that there is in fact an almost consistent and significant trend for the proportion of people previously involved to increase as distance moved through smoke increases. The hypothesis is therefore accepted.

ADDITIONAL ANALYSES

In the preceding analyses we have examined the effects of certain previously-identified key variables upon behaviour. The results of these analyses inevitably raise further questions, some of which it is possible to investigate by additional examination of the present data. Although the analyses in this section appear to fall somewhat outside the main theme of the study, they represent a selection of further results which 'round out' the picture already presented. The analyses are presented largely without comment.

(1) How first became aware of fire/sex

Men more frequently became first aware of the fire by :

(a) seeing flames

(b) hearing shouts

(c) hearing fire alarm

Women more frequently became first aware of the fire by :

(a) seeing or smelling smoke

(b) being told

(2) How first became aware of fire/age

The age of the person does not significantly affect how he first becomes aware of the fire.

(3) Whether or not previously involved in fire incident/Sex

There is a significant difference between men and women in respect of whether or not they had been previously involved. (χ^2 = 110.2, signif. beyond 0.001 level). Men were more likely to have been previously involved in a fire incident than women.

(4) Whether or not previously involved in fire incident/Age

We would expect that in a general way, as age increased so would the proportion of people who had previously been involved. This is illustrated in the data by an increasing trend with age up to the age range 50 - 59, at which point almost 45% of those interviewed claimed to have been previously involved. After age 59, the increasing trend falls off.

(5) Whether or not previously involved in fire incident/Whether knew means escape

We would expect those who had been previously involved to be more likely to know a means of escape. This is supported by the data. A significantly greater proportion of people who had been previously involved knew of a means of escape.

(6) Seriousness rating of fire/Building category

A significantly greater proportion of people regard the fire as 'extremely' serious in the 'home' environment compared to other occupancies. Likewise a significantly greater proportion of people in the other occupancies regard the fire as 'not at all' serious.

(7) Seriousness rating of fire/Position of fire relative to self

We would expect the fire to be rated more seriously if it was on the same floor or below the person. This is only partially borne out by analysis which shows that a significantly greater proportion of people rate the fire as 'not at all' serious if it is above them.

(8) Seriousness rating of fire/Extent of smoke spread & smoke density

There is a significant trend for the proportion of people who rate the fire as 'extremely' serious to increase as extent of smoke spread increases. This result is replicated in the case of smoke density.

(9) Seriousness rating of fire/Age

We would predict that older people would be more likely to rate the fire as extremely serious. However, analysis shows this to be not true. Seriousness rating of the fire is independent of the age of the person.

(10) Knowledge of means of emergency escape/Age

People between the ages of 30 to 59 are significantly more likely to know a means of escape than people in other age groups.

(11) Knowledge of means of escape/Presence of recognised escape routes

As we would expect, where a recognised escape route is present, a significantly greater proportion of people say they know a means of escape. However, 75% of the people who said they knew of a means of escape did so in buildings where no recognised escape route was present. When a recognised escape route was present, 17% of the people said they didn't know a means of escape.

6.0 Discussion and Conclusions

We have attempted to examine behaviour in fires at two levels, a general overview involving description of the actions people made in sequence, and a particular view of factors which effect evacuation of the building and movement through smoke. Many of our hypotheses have been based upon assumption concerning 'correct' behaviour in fires. We have not, however, explicitly attempted to assess the "adequacy" of the behavioural response in relation to the hazard. This lacuna results largely from the difficulty in arbitrating in any specific instance as to what exactly the right course or sequence of actions should be. Each incident represents an almost unique set of circumstances, the number of variables being so large that control or examination of all of them would be practically impossible. From the human viewpoint a possible measure of the "adequacy" of the response might be whether or not the incident involved injury to someone. Inevitably obtaining information from the person injured was often not possible, particularly if the person was hospitalised. It was, however, quite feasible to examine some of the building variables and the behaviour of the other people in the incident, and thus draw comparison with incidents which did not involve injury. Such an analysis might be thought to be even more relevant in cases where a fatality occurred, but as we have seen, the numbers in this category are small, this difficulty being further compounded by the reluctance of other parties to be interviewed, largely because of the fear of incriminating themselves in any subsequent official investigation.

Returning to incidents involving non-fatal casualties, a number of the factors act in a direction which would have been predicted. For instance such incidents were often frequently rated "extremely serious". As smoke spread increased, so did the proportion of people injured; similarly for smoke density. The proportion of people who had never received training is significantly greater in casualty-producing incidents, the proportion of people who knew a means of escape was significantly smaller and the proportion of people who were completely familiar with the building was less in incidents where two or more people were injured. Other factors which might be thought to affect the incidence of casualties appeared to be unrelated to it. The time of the incident, the presence or absence of smoke and the age of the other people in the building appeared to have little effect upon whether or not casualties resulted. In our sample casualties largely occurred in the 'home' enviroment, with a secondary group occurring in hotels.

With regard to actions taken, apparent differences arose between the two types of incidents, a smaller percentage of people contacted the Fire Brigade or fought the fire, whilst a larger percentage investigated, warned others, tried to save effects and moved towards the exit. However, of these differences, only in moving towards the exit did the two groups differ signi-

ficantly under statistical analysis. The points of difference do perhaps indicate that the other people in the building are rather less "socially-oriented" in the casualty incidents, although it would be quite wrong to draw firm conclusions from such an analysis.

It should be emphasised that the above comments refer of course to the reactions of the other people involved in the injury-producing incident, and therefore might be considered a somewhat artificial way of distinguishing between appropriate and non-appropriate behaviour. In addition, the small numbers involved would indicate caution in drawing any general conclusions based upon this particular analysis.

One question which arises is how successful the questionnaire technique has been in studying the problem of behaviour under stress. A criticism which is often levelled at this method is the fact that it relies on what people say rather than what they do. Clearly in some studies it is possible to check the validity of questionnaire measures by obtaining some direct observations of the phenomenon. However the elements of the fire situation tend to preclude this kind of check. One way that the validity of the present data was checked was to require the Fire Brigade Officers who acted as the interviewers to compare the replies given by the respondents with their own first-hand knowledge of the incident. By operating this check approximately twenty of the returned forms were rejected prior to analysis. An additional check on validity was possible after initial coding, by checking and comparing the responses of interviewees from the same incident. The average number of people interviewed per incident was just over two, the highest number being ten, so it was quite feasible to examine a fairly large number for possible anomalies. In addition to these procedures, we feel that the actual nature of the responses lends weight to their veracity. There certainly appeared to be little attempt to deliberately put actions in a good light. It seems likely that many of the people who confessed to an inappropriate action were ignorant of the fact that they were so doing.

It should be pointed out that the sample may be somewhat biased in that the people interviewed tended to be those immediately involved with the fire. This inevitably follows from the use of Fire Brigade officers, who have only a limited time at the scene of the incident, as data gatherers. If the fire occurred in a large building then they could not possibly hope to interview all the people who were aware of the fire, and therefore not surprisingly elected to obtain information from those closest to the actual scene. However even a large team of independant interviewers would be unlikely to obtain a complete picture of the incident, as the time demanded by such an exercise in say a factory containing 200 people, would be quite unacceptable. This possible source of bias should not be over emphasised since in many incidents, particularly fires in houses, all the people in the building were interviewed.

In retrospect, perhaps the least satisfactory aspect of the questionnaire lay in the

unstructured questions relating to the courses of action. Although these were arranged to provide sequential responses, the difficulty when analysing the data arises from having no knowledge of the time scale occupied by each action. The length or brevity of the recorded comments did not appear to be related to the duration of the actions, rendering it difficult to assess over what period of time a person continued to pursue any specific action. This was particularly so when the course of action was a general one, directed mainly towards one end, for instance fire-fighting. It may be that the person was fighting the fire for several minutes, but superficially he appears to be less 'active' than someone who did several specific things, which may well have occupied less time. We feel that any future attempt to study stress situations which are not of very short duration should include some measure of the period of time involved, to provide a more valid basis for comparison between types of behaviour.

A number of aspects of the results were not anticipated. The popularity of fire fighting as a course of action for instance. It certainly seems that the general public are willing to attack the fire more frequently than is popularly supposed. It is clear, however, that the decision whether or not to immediately fight the fire was based to a certain extent upon the person's judgement of the seriousness of the fire, the proportion of people fire-fighting being inversely related to the seriousness judgement. This seems to indicate that people are more likely to attempt to fight the fire if it was thought to be not very serious, and they thus judged that they had a good chance of extinguishing it. However since our data all relates to fires to which the Fire Brigade were called, presupposing a certain level of seriousness, this may also be a comment on lay-people's misjudgement of fire dangers. Unfortunately it was not possible to discover at what stage in the proceedings the Fire Brigade were called, which would shed light upon this problem. It would certainly seem likely that there is some threshold value of "fire-severity", as judged by the person, beyond which people call the Fire Brigade. It may be that this limen is different for different people, depending on age, sex, presence of others and other individual differences. In view of other widespread public misconceptions concerning fire, it would be extremely interesting to discover what factors or combination of factors actually determine the calling of the Fire Brigade.

Frequency of fire-fighting was also closely associated with the type of building, accounting for almost one quarter of the first actions taken in factories compared to only one tenth in dwellings. This being so one would anticipate some correlation with frequency of training but surprisingly this did not emerge. The absence in some cases of a clear-cut relationship between training frequency (and to a lesser extent, familiarity with the building), was to the author one of the major surprises of the investigation. Both the above variables were predicted as being key variables and we feel that further investigation, especially concentrating on the nature and

type of training is urgently needed. This should not be interpreted as an indictment of all training, since the present investigation merely studied one aspect of it, its frequency. It is suggested, however, that little is known about the effectiveness of various types and frequencies of fire training. In view of the large sums of money which are invested in buildings to provide fire escape and fire protection facilities, one must wonder at the small amount of time and effort which appear to be devoted to ensuring that they are used properly.

One of the most interesting aspects of the analysis was the sex differences which emerged. In terms of general actions women appear to be more concerned with the safety of people, themselves included, in that they were more likely to warn others and evacuate family, in addition to being more likely to immediately leave themselves. In contrast men seem more situation-orientated, being more likely to attempt fire-fighting or minimise the risk. With regard to leaving the building over the course of the incident, women were again more likely to leave, contrasting with aircraft emergency experience which in general has shown that a greater percentage of men escape. However in this case the alternative actions are of course extremely limited, the superior strength and size of men appearing to be a determining factor. Frequency of returning into the building and moving into smoke also demonstrate sex differences, the proportion of men being significantly greater in both cases. A surprisingly large percentage of people move through smoke, an action which we were led to believe was fairly rare. Having discovered that this behaviour is fairly frequent one must ask to what end people moved into the smoke. It is demonstrated that moving through smoke is not associated with leaving the building nor with knowledge of emergency escape, and one can only assume that it is undertaken whilst performing some other activity, such as fire-fighting or warning others. However there is certainly room for further research into the reasons for and the conditions under which, people move into smoke.

Previous involvement in a fire incident appears to reduce some of the stressful elements of the fire, since people who had been previously involved were less likely to immediately leave and more likely to fire-fight in addition to moving further through smoke. They were not, however, any more likely to behave in a 'correct' way, such as contacting the Fire Brigade, and indeed were more likely to return into the building. The high percentage of people who returned into the building must be a comment not only upon the ineffectual nature of fire-safety propaganda which invariably preaches the folly of such behaviour, but also the difficulty many people experience in apparently "doing nothing" when their possessions and property are threatened. Having left the building, a certain proportion of people seemingly feel motivated to return in to check 'the progress' of the fire, even if they don't actually do anything about it. If this type of behaviour is liable to occur at all types of fire then one must have some reservations

concerning current thinking on means of escape, which seems to be moving towards a policy of either moving people to a safe place, or persuading them to remain in a safe place without actually leaving the building. If, as we have seen, a certain percentage of people will return into the building for apparently not very rational reasons, then perhaps a similar percentage will wish to leave the 'safe area' within the building rather than remain passive and inactive. This aspect appears to require urgent investigation, initially to see if it is a general problem. If it proves to be so, then one would attempt to identify how large a percentage of people will react in this way, what sort of conditions determine its occurrence, and how such behaviour might be altered or redirected. It undoubtedly seems to go against human psychological needs to merely direct people to a safe place, and then in the face of an extremely stressful, unusual situation, require them to be inactive. These needs are recognised in other forms of disaster or emergency planning, by giving people something to do, even though they may know on a rational level that their actions may not alter a particular outcome. The mere fact of doing something not only lowers the level of threat but may also divert potentially dangerous investigative behaviour.

From the analysis of the present data we may construct a 'probable' picture of people who take certain courses of action. The person who, as soon as they become aware of the fire, immediately leaves the building, will more frequently be female .... consider the fire to be extremely serious .... and not have been previously involved in a fire incident. For fire-fighting the person is more likely to be male ... between 30 to 59 years old ... in the working environment ... and previously have been involved in a fire. Over the course of the incident, in evacuating the building it is probable that the person will again be female ... not know a means of emergency escape ... not have been previously involved ... and never have received any training. The incident is more likely to be one in which dense smoke spreading beyond the room origin occurs. A similar picture for returning into the building reads, men ... between 20 and 39 ... completely familiar with the building .... previously involved .... smoke being present in the incident. In moving through smoke the person is more likely to be male ... completely familiar with the building .... consider the fire extremely serious ... in the home environment .... the incident occurring at night. It is clear that no one factor is acting consistently on all the behavioural variables. However, for specific types of action, it is possible to isolate and examine which variables were important in determining the behavioural responses.

The process of encoding and simplifying that data for computer analysis unfortunately renders examination of some aspects more difficult. One such aspect if the effect of people's actions and communications upon each other, i.e. social effects. We have of course recorded and sorted by the presence and relationships of people in the building, however to obtain a more detailed scrutiny of this factor a sample of incidents at which three or more people were inter-

viewed was examined. Perhaps the most interesting result of this analysis was the essential similarity between behaviour at work and in the home. The cooperative nature of actions in the work environment was often a feature, tasks being allocated and undertaken, assistance to work-mates rendered and people being generally helpful. Most of the larger incidents in fact involved factories, and in the relatively small number of fires at which six or more people were interviewed this active, helpful and cooperative behaviour is shown to a marked degree. In the home, although there were naturally individual differences, this type of behaviour is repeated, albeit on a smaller scale. For instance where families are involved, the roles of husband and wife seem to become fairly stereotyped, in so far as the husband became responsible for fighting or containing the fire whilst the wife was allocated the job of contacting the Fire Brigade and evacuating other family members. Often the "operations" are directed by one specific family member, in many cases the husband, although where a young married couple are living with parents it may well be one of the parents. The apparent ease with which tasks are allocated and roles assumed in this situation, is perhaps a function of the underlying hierarchical nature of family relationships, and is a reflection of the more formalised relationships of work.

Although not a specific aim of the study, the popular belief that "panic" frequently occurs in the fire situation led to the results being examined for evidence of this. We might construe that immediately leaving the building represents a 'panic-type' response. This type of behaviour was associated with high levels of seriousness-rating, our measure of seriousness being intended to indicate the threat level of the person involved. There is some evidence that people did not rate the fire as inappropriately serious, since seriousness is correlated with some of the objective measures of fire severity, such as high levels of smoke spread and density. High seriousness ratings were also associated with fires which occur in the home, although this did not reflect in the proportions of people immediately leaving. It may be that people rated seriousness in terms of threat to property rather than threat to life. Other factors which we would expect to affect our self-defined panic-type response, such as familiarity with the building, and training frequency did not in fact do so, although people who were trained very frequently, i.e. at least once per month, were significantly less likely to immediately leave. It is difficult to draw firm conclusions about the incidence of a panic-type response largely because this study was descriptive rather than analytical. Any post-hoc interpretations of actions involve assumptions whose validity cannot be checked. What we are really lacking, and what obviously follows from this research is some attempt to gain insight into the decision-processes which lead to certain courses of action. In the present research we have simply asked people what they did without reference to what other courses of action were considered and rejected. Clearly we cannot hope to make predictions about such behaviour or attempt to alter it, if we do not have

some evidence as to why people did one thing rather than another. Such more intensive studies will have to look at people's attitudes, knowledge and beliefs concerning fire, in addition to the measures recorded in the present study.

7.0 Appendices

1. Pilot Study questionnaire
2. Pilot Study questionnaire

   Tall buildings version
3. Full Scale Study Questionnaire
4. Notes of Guidance in using Full Scale Questionnaire

BEHAVIOUR OF PEOPLE IN FIRES

Questionnaire to be completed by Fire Brigade Officer, not the person being interviewed. It is only necessary to place a tick in the box opposite the appropriate response.

1) Male ☐ 1 Female ☐ 2

2) Under 25 ☐ 1 25 - 45 ☐ 2 45 + ☐ 3

3) How did you first become aware of the fire?

(a) Heard fire alarm ☐ 1
(b) Smelt smoke ☐ 2
(c) Saw flames ☐ 3
(d) Felt heat ☐ 4
(e) Heard shouts ☐ 5
(f) Were told ☐ 6

4) What was your position (within the building) at that time?

(a) On the same floor close to the fire ☐ 1
(b) On the same floor remote from fire ☐ 2
(c) On the floor above ☐ 3
(d) On the floor below ☐ 4
(e) In a room ☐ 5
(f) In a corridor ☐ 6
(g) Don't know ☐ 7

5) What were your immediate feelings?

(a) Unconcern ☐ 1

(b) Slight worry ☐ 2

(c) Confusion ☐ 3

(d) Excitement ☐ 4

(e) Fear ☐ 5

(f) Desire to escape (move) ☐ 6

6) Did these feelings alter during the course of the fire?

(a) Become greater ☐ 1

(b) Become less ☐ 2

(c) Change completely ☐ 3

7) What did you do as soon as you realised there was a fire?

(a) Went to see where it was? ☐ 1

(b) Prepared to leave the building ☐ 2

(c) Went to warn other people ☐ 3

(d) Enquired whether Fire Brigade had been called ☐ 4

(e) Attempted to call Fire Brigade ☐ 5

(f) Attempt to extinguish it ☐ 6

(g) Operated the fire alarm ☐ 7

(h) Nothing ☐ 8

8) Did you attempt to leave the building?

(a) By your normal route ☐ 1

(b) By another ordinary route ☐ 2

(c) By climbing through a window ☐ 3

9) Did you have any difficulty in moving about due to

(a) Heat ☐ 1

(b) Flames ☐ 2

(c) Smoke ☐ 3

(d) Choking fumes ☐ 4

(e) The actions of other people ☐ 5

(f) None ☐ 6

(If 9 (c), then questions (10) and (11) apply, otherwise omit)

10) How far did you attempt to move through the smoke?

(a) Three feet ☐ 1

(b) Six feet ☐ 2

(c) Twelve feet ☐ 3

(d) More ☐ 4

11) Were you

(a) Walking upright ☐ 1

(b) Running upright ☐ 2

(c) Crouching ☐ 3

(d) On hands and knees ☐ 4

12) How far could you see through the smoke?

(a) Three feet ☐ 1

(b) Six feet ☐ 2

(c) Twelve feet ☐ 3

(d) More ☐ 4

13) Where were you when the Fire Brigade arrived?

(a) In original place ☐ 1

(b) Attempting to leave the building ☐ 2

(c) Outside the building ☐ 3

14) Did you eventually leave the building?

(a) By your own efforts ☐ 1

(b) By the efforts of the Fire Brigade ☐ 2

(c) By the help of others ☐ 3

(d) Not at all ☐ 4

15) Have you ever been involved in a fire incident before?

(a) At home ☐ 1

(b) At work ☐ 2

(c) In another building ☐ 3

This section to be completed by Fire Brigade Personnel only.

Date : Fire at :

Number of storeys :

APPENDIX 2

PILOT STUDY QUESTIONNAIRE - TALL BUILDINGS VERSION

BEHAVIOUR OF PEOPLE IN FIRES IN TALL BUILDINGS

This questionnaire is to be handled by the Fire Brigade Officer, not the person being interviewed. Except for the brief factual details at the beginning of the questionnaire, it is only necessary to place a tick or a number in the box opposite the most appropriate response.

Address of Incident: .....

.....

.....

Date and time: .....

Floor of origin ☐☐

Number of floors ☐☐

Fire alarm provided? yes ☐ no ☐

Fire equipment provided? yes ☐ no ☐

---

1) Male ☐ 1 Female ☐ 2

2) Under 25 ☐ 1 25 - 45 ☐ 2 45+ ☐ 3

3) Flat Number ☐☐☐

4) Floor Number ☐☐

5) How did you first become aware of the fire?

(a) Heard fire alarm ☐ 1

(b) Smelt smoke ☐ 2

(c) Saw flames ☐ 3

(d) Felt heat ☐ 4

(e) Heard shouts ☐ 5

(f) Was told ☐ 6

(g) Were not aware of the fire ☐ 7

6) Which floor were you on when you first became aware of the fire?

Floor number ☐☐

7) What was your position within the building at that time?

(a) In your flat ☐ 1

(b) In the lift ☐ 2

(c) In the corridor/entrance hall ☐ 3

(d) Don't know ☐ 4

8) What what your immediate feelings?

(a) Unconcern ☐ 1

(b) Slight worry ☐ 2

(c) Confusion ☐ 3

(d) Excitement ☐ 4

(e) Fear ☐ 5

(f) Desire to escape (move) ☐ 6

9) What did you do as soon as you realised there was a fire?

(a) Went to see where it was ☐ 1

(b) Prepared to leave the building ☐ 2

(c) Went to warn other people ☐ 3

(d) Enquired whether Fire Brigade had been called? ☐ 4

(e) Attempted to call Fire Brigade ☐ 5

(f) Attempted to extinguish it ☐ 6

(g) Operated the fire alarm ☐ 7

(h) Nothing ☐ 8

10) Did you attempt to leave the building?

(a) By the lift ☐ 1

(b) By the staircase ☐ 2

(c) By climbing through a window ☐ 3

(d) Not at all ☐ 4

11) Did you have any difficulty in moving about due to

(a) Heat ☐ 1

(b) Flames ☐ 2

(c) Smoke ☐ 3

(d) Choking fumes ☐ 4

(e) The actions of other people ☐ 5

(f) None ☐ 6

(If 11(c) is ticked, then questions 12), 13) and 14) apply, otherwise omit).

12) How far did you attempt to move through the smoke?

(a) No distance ☐ 1

(b) Three feet ☐ 2

(c) Six feet ☐ 3

(d) Twelve feet ☐ 4

(e) More ☐ 5

13) Were you

(a) Walking upright ☐ 1

(b) Running upright ☐ 2

(c) Crouching ☐ 3

(d) On hands and knees ☐ 4

14) How far could you see through the smoke?

(a) No distance ☐ 1

(b) Three feet ☐ 2

(c) Six feet ☐ 3

(d) Twelve feet ☐ 4

(e) More ☐ 5

15) Where were you when the Fire Brigade arrived?

(a) In original place ☐ 1

(b) Attempting to leave the building? ☐ 2

(c) Outside the building ☐ 3

(d) Moving nearer to the scene of the fire ☐ 4

(e) Moving away from the scene of the fire ☐ 5

16) How did you eventually leave the building during or immediately after the incident?

(a) By your own efforts ☐ 1

(b) By the efforts of the Fire Brigade ☐ 2

(c) By the help of others ☐ 3

(d) Not at all ☐ 4

17) Have you ever been involved in a fire incident before?

(a) At home ☐ 1

(b) At work ☐ 2

(c) In another building ☐ 3

(d) No ☐ 4

University of Technology,
Loughborough,
Leicestershire.

April, 1970.

APPENDIX 3

FULL SCALE STUDY QUESTIONNAIRE

(THE FULL QUESTIONNAIRE CONTAINED 6 COPIES OF PART 2.)

The Behaviour of People in Fires

We are trying to find out if people react differently to fires in different kinds of building. This set of questionnaires is concerned with one particular incident and is composed of two parts.

Part I, which is about the fire and the building should be answered by the Fire Brigade Personnel. Part II comprises the six subsequent questionnaires, which are about people involved in the fire. The questionnaires in Part II are for use in interviewing six separate individuals who were in the building when the fire was discovered. We are interested in anyone who was in the building, not only the person who first discovered the fire.

We would therefore like you to interview as many people as possible who were involved with the incident. Both Part I and Part II should be handled by Fire Brigade Personnel, not by the person being interviewed. Where a question is followed by a list of suggested alternatives please tick the box opposite the most appropriate answer. Where a distance estimate is required please circle the relevant number.

Part 1 Information on the Building and Type of Fire

Address

Date

Time

K433 Report Sheet Number

1 Is a fire alarm (manual or automatic) provided in the building? ..... Yes ☐ No ☐

If so, was it used? ..... Yes ☐ No ☐

2 Is fire fighting equipment provided in the building? Yes ☐ No ☐

If so, was it used? ..... Yes ☐ No ☐

If fire fighting equipment is not provided, was any-other attempt made to extinguish the fire before the Fire Brigade arrived? ..... Yes ☐ No ☐

4 Are there any recognised escape routes in the building? ..... Yes ☐ No ☐

If so, were they used? ..... Yes ☐ No ☐

If "No", please specify why not

5 What category of building is it? *In general terms, for example – school, block of flats, shop, cinema, private dwelling house, multi-occupancy dwelling, etc.*

6 What is the maximum number of storeys in the building? .....

7 On which floor did the fire start?
Basement = –1, ground = 0, first = 1, etc. .....

8 Approximately how many people do you think were in the building when the fire was discovered?
Please put the number in the box .....
Approximately how many left the building during the course of the fire? *If all, write ALL* .....
How many people were rescued by Fire Brigade Personnel? .....
How many people were injured non-fatally? .....
How many people were injured fatally? .....
How many people were injured (fatally or non-fatally) in escaping the building? .....

9 How many
rooms were involved in the fire .....
levels were involved in the fire .....
constructions were involved in the fire .....

10 How many jets were utilised? .....

11 What was the extent of the smoke spread?
None .....
Confined to room of origin .....
Confined to floor of origin .....
Spread to floor above .....
Even more extensive .....

12 What was the density of the smoke at its worst?
If, on the scale below, 7 represents the thickest smoke you have ever encountered, and 1 represents very thin smoke, put a cross in one of the spaces which represents the density of the smoke in this incident.

1 ☐ ☐ ☐ ☐ ☐ ☐ ☐ 7

Part 2 Information about the Person in the Fire

Male ☐ Female ☐ Age ☐

1 How did you first become aware there was a fire?

- Felt heat ☐
- Saw flames ☐
- Saw or smelt smoke ☐
- Heard noises associated with the fire ☐
- Heard shouts ☐
- Was told ☐
- Heard fire alarm or fire engines ☐

Something else *please specify*

2 When you realised there was a fire, how serious did you think it was?

- Extremely serious ☐
- Quite serious ☐
- Not at all serious ☐

3 Which floor were you on when you realised there was a fire? ☐

4 Do you either live or work in the building? Yes ☐ No ☐

5 How familiar are you with the layout of the building?

Are you
- completely familiar with it ☐
- fairly familiar with it ☐
- slightly familiar with it ☐
- not familiar with it ☐

6 What was the first thing you did when you realised there was a fire?

What did you do next?

and next?

7 How often have you received training on what actions to take in a fire?

- At least once per month ☐
- At least once every six months ☐
- At least once every year ☐
- Less frequently than once a year or never ☐

8 Did you know of any means of emergency escape in the building? Yes ☐ No ☐

9 Did you leave the building during the fire? Yes ☐ No ☐

If NO, please pass on to question 10

In leaving did you use

- The normal exits ☐
- An emergency exit ☐

Some other way *please specify*

Did you leave by
- Your own efforts ☐
- With Fire Brigade help ☐
- With the help of others ☐

Did you return into the building during the course of the fire? Yes ☐ No ☐

If you did, for what reason?

10 What reason did you have for not leaving? Was it because

- You did not think the fire was serious enough ☐
- You thought you would be safer where you were ☐

Some other reason *please specify*

11 Was there any smoke? Yes ☐ No ☐

If NO, omit the rest of this question

Did you try to move through it? Yes ☐ No ☐

If NO, omit the rest of this question

How far did you try to move through it?

Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+

How far ahead could you see at the time?

Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+

Did the smoke become thicker? Yes ☐ No ☐

Did you have to turn back because of it? Yes ☐ No ☐

If NO, omit the next part of the question

How far ahead could you see when you turned back?

Yards .... 0 .... 2 .... 4 .... 10 .... 12 .... 15 .... 20 .... 20+

12 Were any of the following people with you in the building during the fire?

- Your children under 12 ☐
- Your children over 12 ☐
- Your wife/husband ☐
- Your parents ☐
- Some other relative ☐
- Friends ☐
- Acquaintances ☐
- People unknown to you ☐

13 Have you ever been involved in a fire incident before? Yes ☐ No ☐

APPENDIX 4

NOTES OF GUIDANCE FOR APPLICATION OF FULL SCALE QUESTIONNAIRE

Revised Notes of guidance for the completion of questionnaire on "Behaviour of People in a Fire Situation"

General

The questionnaires are applicable to fires in buildings which are occupied at the time of the fire.

Each questionnaire consists of a booklet of seven pages. The first page is PART I of the questionnaire and the next six pages are identical PART II's. PART I is addressed to the Fire Brigade, and apart from the address, it is envisaged that it will be completed at some time subsequent to the fire.

The six PART II's are intended to be used in interviewing up to six people at the scene of the fire.

The number of PART II's has been settled at six as this seems a reasonable maximum number to aim for at any fire. However, if more than six people were seen, other booklets could be used.

Nationality of people interviewed - Although there is no space on the form for noting this information, it has been pointed out that this may well effect behaviour. Therefore if the person is not British, and where it would not cause offence, it would help if his nationality was written on the PART II concerned, in the space between the line, "Male", "Female", "Age", and Question 1, "How did you first become aware of the fire?".

Age limit of people interviewed - Again, although no specific minimum age limit is stated for persons being interviewed, it is considered that a sensible minimum would be 10 to 12 years old.

Number of People interviewed - There is no maximum number for the people interviewed. We would like as many people as possible in the light of the circumstances and time available. As far as possible we would like a cross-section of the people involved.

Accuracy of information obtained - It is recognised that some of the people interviewed, will for their own reasons either exaggerate, or tell outright lies about their actions. In many cases this will be obvious to the Fire Brigade Officer using the questionnaire. In such a case, if the Fire Brigade Officer has good reason to believe that the information given by any person is largely inaccurate, it would be useful if he could endorse the back of the particular interview sheet with a comment to this effect.

So long as the completed questionnaires are legible, it does not matter if they are dirty or marked from being used at the scene of a fire.

Notes about specific questions

PART I

Time	:	This refers to the time of first call to the Brigade.
Question 2	:	This means any recognised first-aid, fire-fighting equipment i.e. fire-buckets, hose-reels etc.
Question 7	:	For example, for a bungalow "0" would be written in the box.

Question 8 : Where the number is small, less than 10, it is more important that the exact number is entered.
Where the number is between 20 and 60, an approximation to the nearest 10 people is acceptable.
Where more than 60 people were estimated to be in the building, an approximation to the nearest 50 is acceptable.
If in any case the answer is none, but a "0" in the box.
If the answer is not known at all, put a question mark in the box.

Question 12 : This question is to try and get some idea of how thick the Fire Brigade judge the smoke to have been at its worst. For example, if the smoke was about halfway between "very thin" and the thickest ever encountered by the member of the Brigade completing the questionnaire, the cross would go in the middle box.

PART II

Age : An approximation, i.e. 40 - 50, 35 - 45 is acceptable.

Question 1 : More than one alternative may be ticked if the person was simultaneously aware of a number of the effects of fire.

Question 6 : Brief statements are in order here. (for example, "Got dressed", "went to door", "ran down corridor", etc.)
More than one such statement may be put in each box.

Question 7 : This means training in its most general sense, to include any form of instruction concerning what to do in fire. i.e. visits or lectures by firemen etc.

Question 9 : If the answer is "yes" to this, ignore Question 10.

Question 12 : More than one alternative may be ticked.

8.0 Selected References

Berkun, N.M., et al (1962) — Experimental Studies of Psychological Stress in Man. Psychol. Mon., 76, (534)

Campbell, D., et al (1964) — Characteristics of a conditioned response in human subjects during extinction trials following a single traumatic conditioning trial. J.Abnorm. and Soc. Psychol. 68, (627)

Cantrill, H., (1947) — The Invasion from Mars Princeton : Princeton Univ. Press.

Drever, J., (1958) — A Dictionary of Psychology London : Penguin Books

French, J., (1941) — Experimental Study of Group Panic J. of Elisha Mitchell Soc., 57, (195)

Kelley, H.H., et al (1965) — Collective behaviour in a simulated panic situation J. Exptl. Soc.Psychol., 1, (20 - 54)

Lucas, R.A., (1969) — Men in Crisis - A study of a mine disaster. New York : Basic Books

Mintz, A., (1951) — Non-adaptive group behaviour J. Abnorm. and Soc. Psychol., 46, (150 - 159)

Schultz, D.P., (1966) — An experimental approach to panic behaviour Office of Naval Research Contract Number, NONR - 4808 (00) AD - 637604

Schultz, D.P., (1967) — Individual behaviour in a simulated panic situation Final Techn. Report., Contract N00014 - 67 - C - 0131 North Carolina University - Charlotte AD - 661356

Sjoberg, G., & Nett, R. (1968) — A methodology for Social Research New York : Harper & Row

Snow, C.C., et al (1970) — Survival in Emergency Escape from passenger aircraft. Federal Aviation Administration Report No. AM 70 - 16

Wherry, R.J., & Curran, P.M. (1966) — A model for the study of some determiners of psychological stress: Initial experimental research. Organizational Behaviour & Human Performance. 1, 226 - 251