THE DETERMINANTS OF RISK PERCEPTION: THE ACTIVE-PASSIVE DIMENSION

E. Swaton*
R. Maderthaner**
P.D. Pahner*
G. Guttmann**
H.J. Otway***

October 1976

* International Institute for Applied Systems Analysis and Joint IAEA/IIASA Research Project, International Atomic Energy Agency, P.O. Box 590, A-1011 Vienna, Austria.

** Psychological Institute, University of Vienna, and Joint IAEA/IIASA Research Project, International Atomic Energy Agency, P.O. Box 590, A-1011 Vienna, Austria.

*** Project Leader, Joint IAEA/IIASA Research Project, International Atomic Energy Agency, P.O. Box 590, A-1011 Vienna, Austria.

PREFACE

Risks have emerged as a major constraint to the introduction and development of technological systems. The work of the Joint IAEA/IIASA Research Project (IAEA = International Atomic Energy Agency) is directed toward gaining an improved understanding of how societies judge the acceptability of new technologies and how objective information on risks, and the anticipated responses to them, may be considered in decision-making. This pilot study presents a technique utilizing photographs of risk situations and was designed to elicit additional psychological determinants of risk perception.

ABSTRACT

In this paper the suitability of using photographs as a testing technique for identifying additional factors as determinants of risk perception is discussed.

A survey was performed, showing 30 slides to 222 respondents (90 males, 132 females). The risk situations presented were to be evaluated on a rating scale. Factor analytical treatment of data revealed two factors, where the first factor can be interpreted as a "general risk" factor. The second factor displayed a two-dimensional structure, the poles of which were designated "active" and "passive" with regard to the persons depicted in the various situations. The "active" dimension is described by a permanent struggle with the event, whereas the "passive" dimension is characterized by a submissive ability of endurance with little influence through personal skill on the situation. Technological risk situations (i.e., interaction between man and his technical environment) are mainly located on the passive side of this bi-polar continuum. Here also statistically significant differences between male and female respondents were found.

I. INTRODUCTION

In the past few decades there has been a rapid increase in technological development; only recently have rather generalized concerns about its often unexpected negative side effects been heard. Some of these risks can be documented by conventional statistical measures. Many, however, lack a statistical data base and their effects may be predicated only upon the basis of "objective" calculations. In neither case are insights provided into the human response to risk situations.

In order to help structure investigations in this area, Otway and Pahner (1976) developed a conceptual framework and research plan for risk assessment studies. Risk situations are considered by them to be characterised by a number of "levels". The first level is that of the physical risks presented by a particular facility or technology; the next level is that of how these risks are perceived by individuals; the third level consists of the psychological effects upon individuals as they respond to these perceptions and the final level is the risks to social structures and cultural values as individuals express their concerns through their participation in interest groups.

Considerable attention has been paid to the first level, the "objective risks" posed by different technologies. This work, however, does not extend to the realm of the second level, where little research has been done to find out how various risk situations are perceived and what factors, psychological or otherwise, influence the perception process, even though the perception of risk situations is important in determining the responses to them. In a study on responses to environmental risks conducted in Canada by Golant and Burton (1969a), it was seen that experience with certain risk situations may variously affect assessment of the risk. A parallel study performed in Austria by Otway, et al.(1975),

indicated that the subjects' ability to imagine themselves in the hazardous situation is also an important variable in ranking response to the risk in question. Depending on the nature of the investigation and the methods used, two or three different bases of classification applicable in dealing with the dimensions of a risk situation have been found. Initially Golant and Burton (1969a) suggested a sub-division into "physical, natural and social hazards", but they then (1969b) differentiated between "man-made, natural and quasi-natural hazards" in a subsequent factor analysis of assigned properties ("semantic differential"). An Austrian investigation by Maderthaner, et al. (1976) developed a ranking of the perceived risk associated with seven types of technological facilities and indicated the role of confrontation with the situation as a factor influencing perception.

The pilot study to be reported here presents a technique, utilizing photographs of risk situations, designed to elicit additional psychological determinants of risk perception. The method is described in Section II, the experiment and methodology in Section III. Section IV deals with the interpretation of data, and some concluding remarks are presented in Section V.

II. METHODS

The instrument most frequently used to obtain data in the field of situational risk perception is the questionnaire. Here hypothetical situations are presented and evaluated. They are mostly of a semi-projective nature asking the subject how he would advise others in the situation described, assuming that the advice to others would reflect his own stand (Kogan and Wallach, 1964; Rettig and Rawson, 1963; Merz, 1963). Inspection of the situations described in these questionnaires revealed quite a strong connection with the cultural context of the country where they were designed. For instance, the North American questionnaires had to be altered to be applicable for European use (Lamm and Kogan, 1970; Lamm, Schaude and Trommsdorff, 1971).

This objection, the importance of imaginability and the fact that many of the man-made and natural hazard situations have most likely not been experienced by individuals in many European countries, led us to the idea of using photographs.

The following requirements had to be met by this different approach for investigating the perception of risk:

1) The situations presented should be clearly understandable and should contain no immediate cultural dependence;
2) The method for eliciting judgement should be easily administered and the responses reliably measured.

As a solution to the first requirement, great effort was given to find photographs where a single individual is shown in a situation that could be considered more or less risky. To exclude misunderstanding to as large an extent as possible, a definite and easily recognizable occupation was presented in each case. 30 photographs were chosen from different books and journals. Among these were National Geographic, Aviation Week & Space Technology, The Alaska Earthquake, Wild Rivers of North America and a selection

from the USIS photographic library. Roughly speaking, they can be divided into natural hazard situations and man-made hazards, which were subdivided into working situations and sport activities. For test usage, all photographs were transformed into black and white slides.

The second requirement, regarding the measurement procedure, is met by applying a direct scaling method. The form of response should not be so complicated as to distract subjects from thoroughly studying the situation to be evaluated. The rating scale technique is used in experimental psychology for quantifying strictly psychological attributes. Each stimulus is to be judged in absolute categories, but as Thurstone (1967) holds, when two perceptual processes are similar, they tend to be placed adjacently on the imaginary psychological continuum. The first stimulus is judged almost at random, but the observer soon adjusts himself to the range of stimuli encountered and uses the categories consistently and in fair correspondence with the stimuli presented (Woodworth and Schlosberg, 1971).

The rating scale used in this experiment consisted of a line of 10 cm in length with two poles:

not risky at all ——————————————— extremely risky .

Subjects were asked to place a check mark on a single position on the line in order to express their judgement of the situation shown.

III. THE EXPERIMENT

This pilot study was performed on psychology students. On three subsequent days, lecture time was used to explain and demonstrate the application of rating scales. The test was then administered, with the following instructions:

> You are to rate each slide on a line where one pole indicates a "not risky at all" opinion and the other pole an "extremely risky" one. What you see falls somewhere on the scale. Your task is to designate your personal opinion with a check mark at a single point on this line, thus reflecting the degree of riskiness. Please judge each picture as independently as you can, make a rather spontaneous judgement and write it down as quickly as possible; thinking too long will only confuse you. There is no right or wrong answer, we just want to know how you judge the slides. Please do not forget to try to use the whole scale for better expression of your opinion. Any questions?

These instructions were given and sheets for recording the answers were distributed. At the top of the sheets the question "How risky do you think this person's actions are?" appeared. 30 rating scales, one for each photograph, could be found below.

The 30 slides were projected in random order. The room was slightly dimmed for better visibility of the slides on the screen. Each individual slide was exposed for 10 seconds, during which time the subjects adjudged the situation and recorded the marks they felt to be most appropriate on the response sheets. This procedure was maintained throughout the experiment. The slides were not designated on the response sheet with any numbers, code letters or titles. A list of photographs used is attached as Appendix I. The total number of subjects was 222, 90 of whom were male and 132 of whom were female. The mean age was 22.4, with a standard deviation of 4.5.

EVALUATION

A stencil dividing the line in nine sections was used to obtain a score: section 1, which is identical with one point, stands for a "not risky at all" judgement; this system ranged in whole units up to section 9, which is equivalent to nine points for an "extremely risky" judgement. These data were used for calculating a factor analysis in order to trace some general determinants for the perception of risk.

TREATMENT OF DATA

Individual ratings of the 30 photographs given by each subject formed the basis for the calculations. Not all of the data showed an even distribution, therefore correlation coefficients were calculated on the basis of rank-correlations with consideration given to the ties. The thus obtained correlation matrix was then subjected to factor analysis.

As factor analysis is a mathematical process permitting the depiction of complex interdependencies between variables (correlation matrix) in a simplified way, it permits one to find description dimensions that are independent from each other. Since vector calculation is applied, factor analysis belongs in this case to analytical geometry; therefore the single variables are understood as vectors and their intercorrelation as angles between vectors. The Euclidean space built by these vectors of variables is analyzed by means of appropriate calculation processes (e.g., matrix calculus) according to the number of independent dimensions (factors) that are necessary for its adequate depiction. In such a multi-dimensional system of coordinates, each vector may, according to its direction, be proportionally allocated to the various factors. The degree of allocation is called weighting and may be seen as the correlation of a specific factor with a certain variable. The communalities which are usually given at the end of factor analytical calculations indicate the percentage of variation of characteristic variables which can be described by the factors extracted. For further information on factor analysis see Harman (1960).

IV. INTERPRETATION OF RESULTS

Means and standard deviations for the total sample are shown in Appendix II. The distribution of means on the continuum for the total sample is delineated in Figure 1.

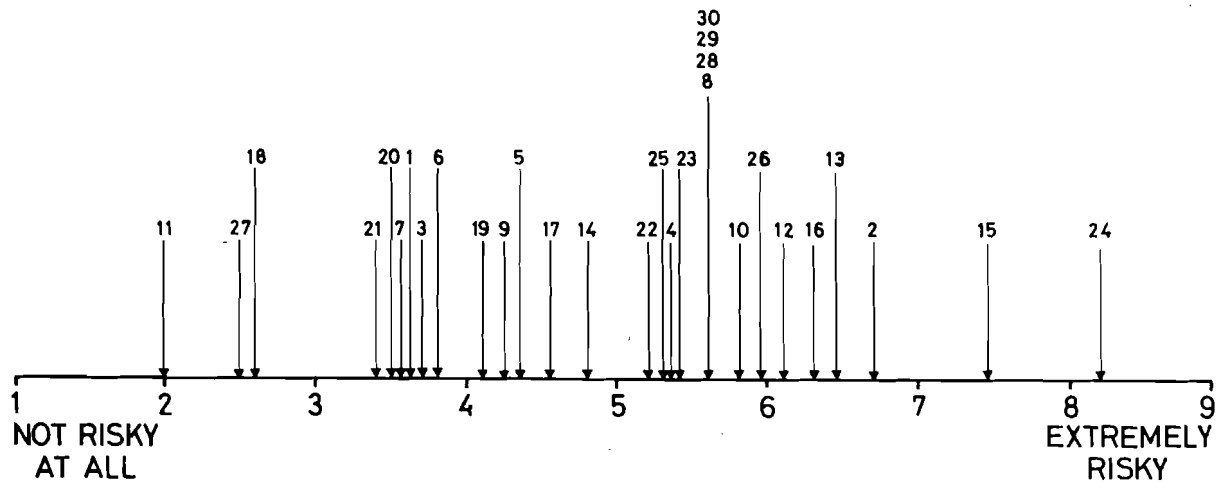


Figure 1: Distribution of Means/Total Sample.

Factor analytical calculation offers the results presented in Appendix III. A distinctive pattern could be found only when a two-factorial structure was applied.

The first factor can be interpreted as a "general risk" factor, as inspection of the factor matrix shows a moderately high but even loading for almost all items. This factor can be interpreted as the inherent risk that was perceived in all photographs presented.

Two photographs showed very low loadings--Nuclear Reactor and War. When considering the position of these two items with respect to their means, one finds that they are located at either end of the continuum (see Figure 1). This might be interpreted as being too far out of the risk dimension: one is perceived as not risky at all (Nuclear Reactor), the other one (War) contains all too obviously imminent danger to life.

Interpretation of the second factor implies a bi-polar dimension. We chose to identify the one extreme of this dimension as "active" and the other as "passive" with regard to the persons depicted in the various situations. The loading values of these two factors are shown in Appendix III, second row. When trying to identify the second factor with its bi-polarity, the interpretation concentrates mostly on the poles, although a floating transition does connect them.

Active: This dimension is described by a permanent struggle with the event. A physically competitive attitude is characteristic of these types of situations. The task itself is challenging, uncertainties are known and it is possible for the individual to exert control over the outcome. Personal activity is needed to manage the situation.

Passive: Here a passive ability of endurance is required once one has encountered a situation of this type. Only minimal influence through personal skill is expected to be possible, only part of the uncertainties are known and outcomes can hardly be controlled by the individual. The situation is felt to require passive surrender accompanied by inherent anxiety and even suffering.

The passive dimension is characterized by items 1, 2, 3, 4, 5, 8, 11, 21 and 22; the active dimension by items 12, 14, 20, 23, 24, 25, 26 and 29, and the remaining items constitute the floating transition, tending toward either the more active or more passive area (see Table 1 and Appendix IV).

A t-test was calculated between the means for each photograph in order to get additional information about the differences in evaluation for males and females. This calculation was based on data represented in Figures 2 and 3, and its results can be found in Appendix V.

Table 1. Dimensional Grouping of Items.

Passive:	(4)	Crane
	(1)	Crucible
	(5)	Radio-active Laboratory
	(2)	High-tension Mast
	(3)	Deep Sea Diver
	(11)	Nuclear Reactor
	(22)	Explosion
	(21)	Earthquake
	(8)	Window Cleaner
Active:	(14)	Hanging Bridge
	(23)	Forest Fire
	(24)	War
	(12)	Steep Rock
	(29)	Inflatable Canoe
	(25)	Helicopter
	(26)	Hang Gliding
	(20)	Yacht

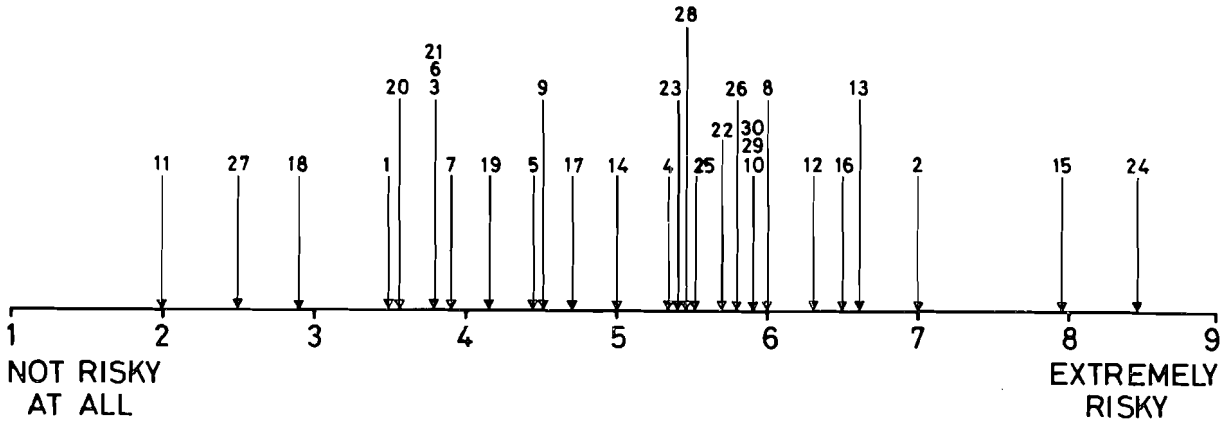


Figure 2: Distribution of Means/Female.

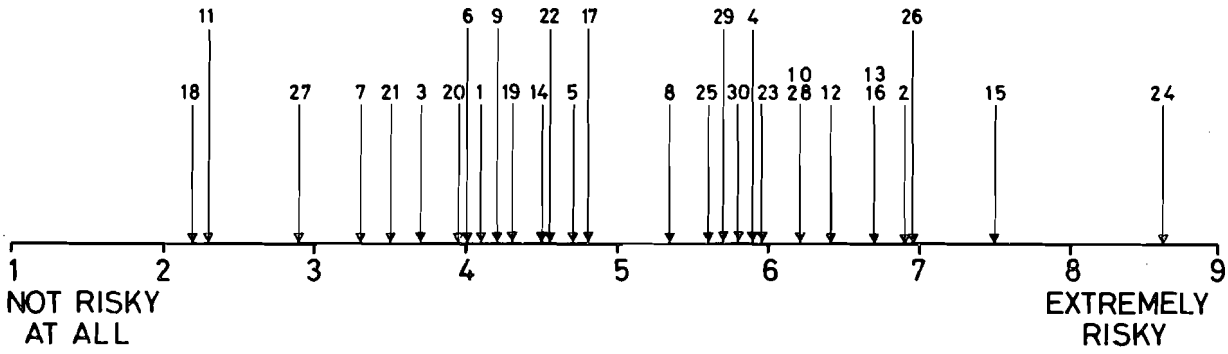


Figure 3: Distribution of Means/Male.

V. CONCLUSION

The intention of this study has been to examine the applicability of photographs for the purpose of investigating the perception of risk. Perception here is defined as the individual's capacity to observe and interpret complex situations. Little research has been undertaken to date to determine how various risk situations are perceived. This new approach is characterized by the following:

1. Photographs of definite risk situations are chosen showing interactions between man and his surroundings (technical and natural). Visual presentation can convey the information needed for respondents to determine the presence, absence or nature of risk by themselves.
2. These risk situations have little or no cultural context; thus this type of questionnaire could be administered to respondents from other industrialized countries, as education and experience provide them with the knowledge necessary to comprehend and interpret the subject matter depicted.
3. A scaling method which is easily explained and administered by the experimenter and readily understood by the respondents is applied.

The results of this study suggest that the presentation and evaluation of photographs are an appropriate method for studying the perception of risks, particularly technological risks. Also this method could be administered to a broader group of respondents in different countries with different educational backgrounds.

Evaluation of data by factor analysis revealed two factors. The first was a "general risk" factor present in all items. The second factor produced two dimensions which were regarded

as a bi-polar continuum. The two poles suggested an interpretation where one pole was designated "active", the other "passive". It is this latter finding which allows for psychological interpretations. Active involvement in a risk situation may tend to reduce the perception of this specific risk. The combination of knowledge, experience and conscious awareness of the risk inherent in the situation may facilitate mastery of a particular level of anxiety. In these situations the individual rates the risk as relatively low.

Passive involvement in a risk situation may tend to raise levels of anxiety and therefore increase the level of perception of the risk. Here little control can be exerted by the individual, thus conscious and unconscious fears are generated.

These variables of activity and passivity as they relate to the perception of life experience have been discussed extensively by Fried (1970), who uses them in interpreting real-life situations. Research on risk-taking has revealed a closely related classification. Here the dichotomy of "chance" and "skill" was introduced. "Chance" refers to tasks where the outcome depends purely on luck, whereas personal ability is needed to succeed with the tasks requiring "skill" (Cohen, 1960; Kogan and Wallach, 1964, 1967). Similar arguments are used here to define the active-passive dimension.

Technological risk situations are located on the passive side of the bi-polar continuum. Thus they are perceived as being dependent on chance and luck, where the outcome cannot be controlled or influenced by personal skill. In these cases a higher level of anxiety may be generated, thus producing a greater perception of risk. According to the results, female respondents tended to perceive greater risk than males when confronted with the same situations. Here again it is the passive dimension which shows the significant difference. As these results may be partly influenced by individual and also cultural variables, one should be cautious in making generalizations.

Further and more sophisticated studies are planned in order to identify additional determinants in the perception of risk situations. Attention will particularly be given to the exploration of the passive dimension and its potential determinants. In these forthcoming studies, larger and more heterogeneous groups will be tested. Thus, more representative results are expected, and these may serve to confirm the above-mentioned findings.

APPENDIX I: AN ANNOTATED LIST AND DESCRIPTION OF PHOTOGRAPHS

(1) Crucible: A man is manoeuvring a huge crucible which is pouring molten steel into moulds. Less risk was indicated by females than by males. This was quite well recognized by members of both sexes, with a few non-identifications from females, who might have had more difficulty in imagining the technical conditions and their danger.

(2) High-tension Mast: A man near the top of a high mast is balancing between a horizontally outstretched ladder attached to the mast and a cable leading to it. He is presumably making adjustments or repairs on the cable. This was rated as extremely risky by members of both sexes--more so, however, by females than by males. It is a clearly identifiable situation which contains two types of risk:
(a) the risk of falling, which is not technical at all;
(b) the risk of touching high-tension cables.
Unfortunately, it is not possible to distinguish which kind of risk was evaluated by the subjects (Ss).

(3) Deep Sea Diver: A skin diver equipped with an oxygen tank swims along the ocean floor. Most of the Ss designated this as moderately risky; it was again regarded as somewhat more risky by the females. Several of the Ss had problems in identifying the situation as the slide was not as clear as expected.

(4) Crane: A man stands on a crane which is hanging from a large scaffold. This was seen by members of both sexes as risky, but more so by females. The situation depicted was not understood by quite a few females, whereas

identification posed no problems for the males. The danger of falling was comprehended to some extent, but as the picture does not indicate the height of the crane, the danger indicated by the respondents may reflect other risks than that of falling.

(5) Radio-active Laboratory: A man wearing a special protective suit, boots and gloves is testing some material which rests on a short holder in his hand. Except for a table with some equipment on it, the room in which he stands is bare. The respondents rated this as having moderately low risk. Females had difficulty in identifying the situation.

(6) Horse Racing: A woman on a galloping horse is just turning a corner of a race track. Mud flies beneath the horse's feet and a cloud of dust follows them, indicating considerable speed. Risk perceptions in this case are spread out on the continuum, with the majority, however, in the moderately low range. The situation was very clear and easily recognized by all participants.

(7) Child on Rope: A boy is traversing a pond by swinging on a rope which he clutches tightly. This situation was regarded by females as being significantly more risky than by males. Many of the females also had problems with identification.

(8) Window Cleaner: The camera man who took this picture was presumably standing on the roof of a high building looking downward. The result is therefore a bird's-eye view of a man standing on a rack (which is suspended by cables) cleaning a window. A street with traffic can be observed far below. The males evaluated this situation as significantly less risky than the females. Many of the females, however, had difficulty in identifying the situation as the angle and lighting made the window cleaner somewhat difficult to distinguish.

(9) Scientist in the Arctic: A scientist in snow attire adjusts two photographic apparati on tripods in a snow storm. The situation was identified by all Ss and considered to be more risky by males than by females.

(10) Man on Rope: A man hangs on a rope while being lowered from a helicopter into a forest. This situation was well understood by all Ss and was rated on the high side of moderately risky by members of both sexes.

(11) Nuclear Reactor: A young girl is fishing on the shore of a lake. On the opposite bank there is a nuclear power plant. A very low risk perception level was obtained here. Surely, some of the Ss did not recognize the buildings in the background and were therefore unable to identify any risk in the situation.

(12) Steep Rock: A lone alpinist, wearing a back-pack and metal helmet, climbs an emense verticle rock. The risk perception was on the high side of moderately risky for this clearly understood situation. Mountain climbing is practiced by members of both sexes, but as physical strength is required, the female respondents rated this as slightly--although not very significantly--more dangerous than the males.

(13) Outer Space: An astronaut has just opened the door of his space module and is climbing out into space. The Earth can be seen in the background. Members of both sexes regarded this as quite risky, although quite a number of females could not identify the situation.

(14) Hanging Bridge: A man sits on a long and extremely narrow rope bridge which hangs over a jungle gorge or river. He is evidently replacing one of the ropes on the side of the bridge. Females saw this as being slightly more dangerous than males.

(15) Skyscraper: A man stands on a ledge at the top of a skyscraper and with gestures directs the transportation of some unseen object. A skyline of high-rise buildings in the background indicates that he stands at a considerable altitude. Although this was regarded by all Ss as very risky, the female ratings were significantly higher than those of the male participants.

(16) Race Car: A race car with the number 13 still speeds along the track. It has just lost a wheel, which flies through the air toward the spectators. In this clearly identified situation, the lost wheel seems to be an acute sign of danger. It was therefore assessed as highly risky by members of both sexes. Only a few "experts" among the Ss were not at all troubled by this occurrence.

(17) Sawyer: A man using an electric saw cuts into a large tree stump. Saw dust and chips fly in all directions, landing on the sawyer as well as on his surroundings. This was regarded as being moderately risky, although some respondents (of both sexes) had difficulty in identifying the situation.

(18) Tractor-harvester: A tractor-harvester is being driven down a steep hill of a wheat field. The risk of this clearly identified situation was generally thought to be quite low, although the female Ss rated it significantly higher.

(19) Shunter: A man in a shunting station is presumably directing a train with large tanks for fluid cargo transport towards another to be hitched. He balances on the edge of the last car and grasps the wheel regulating the brakes. A few females did not understand the picture, but otherwise the situation did not seem to contain much risk for any of the respondents.

(20) Yacht: A single man sails a wooden yacht on sunny but rather turbulent seas. Foam and water spray over the bow. There is no land in sight. This clearly identified situation was seen to be less dangerous by women than by men.

(21) Earthquake: A man stands in an open space before a blocked-off road. Several partly devastated buildings, one of which appears to have been a large department store, border the street. Many of the Ss were unable to identify this picture, perhaps because it was not clear that this condition had been caused by an earthquake. Those who did enter responses displayed wide variance, and results were spread over the whole continuum. In general, however, females perceived significantly more risk in this situation than males.

(22) Explosion: In the foreground a man stands on a dirt road of a construction site under a large crane or dredger. Behind him is a large, evidently wooded hill. Skeleton towers for mining or cable support are visible at the foot of the hill. An explosion at its top thrusts soil and debris out and downward. Females considered this situation to be significantly more dangerous than males. More males had difficulty with identification of the event than females.

(23) Forest Fire: A parachutist descends into a densely forested area directly above the source of a thick cloud of smoke. This well understood situation was ranked by most participants as moderately risky.

(24) War: A soldier in combat uniform holds a machine gun and is poised in readiness. In the background an explosion points to an ongoing battle. This was unanimously considered to be the most dangerous situation. Quite clearly understood, war seems to pose a considerable threat to all Ss.

(25) Helicopter: A man is flying a primitive helicopter composed of only a seat, blades, a simple steering apparatus and legs for landing. This situation was clearly recognized and members of both sexes viewed it as having a moderate level of risk.

(26) Hang Gliding: A hang glider is seen swooping down for a landing. This activity was clearly recogized. Males indicated a definite perception of risk, whereas the female's rating was significantly lower.

(27) Boat and Reactor: A small boat crosses a river on whose far shore a nuclear reactor is located. As the slide was rather indistinct, it could not be identified by a large number of the Ss. When recognized, a low degree of risk was indicated.

(28) Log Transport: Two logs swing from the cable which is conveying them. A man stands directly under the logs. Many members of both sexes failed to identify this scene, but of those who did respond, the females found significantly less risk in this situation than males.

(29) Inflatable Canoe: A canoeist wearing a life-preserver is shooting rapids on an inflatable canoe. He holds the paddle above his head as he is swept by the current among large rocks. Water foams on all sides and has splashed into the canoe. This situation was clearly identified and regarded as being moderately dangerous.

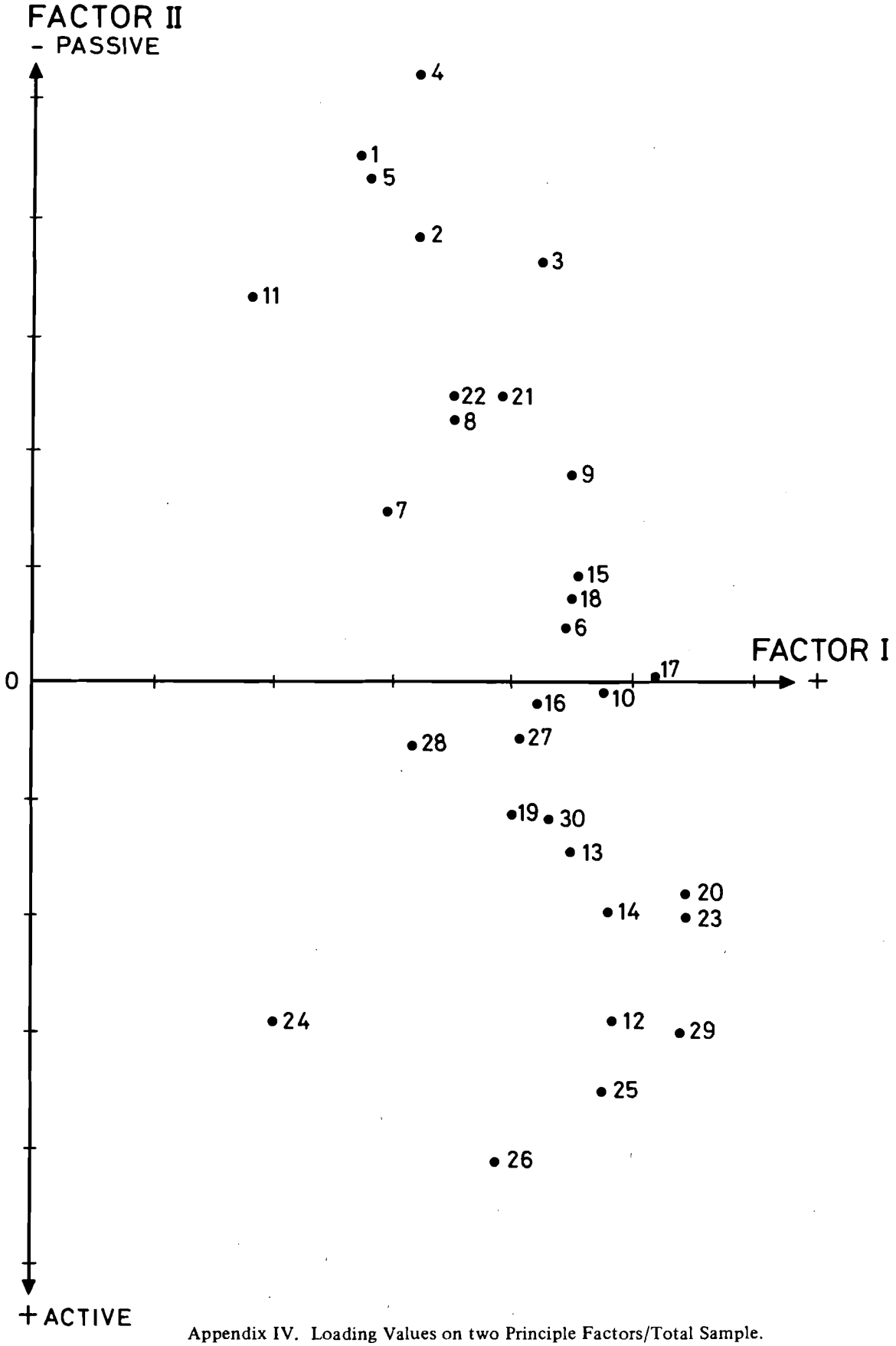
(30) Parachutist: Looking down from the open hatch of an airplane one sees a parachutist descending in free fall. The area beneath him is partly snow-covered. In general, a moderate level of risk was perceived here, with female ratings significantly higher than male ones. Some of the female respondents were unable to identify the situation.

APPENDIX II: MEANS AND STANDARD DEVIATIONS/TOTAL SAMPLE

	Title	Means	Standard Deviations
(1)	Crucible	3.604	2.238
(2)	High-tension Mast	6.734	2.238
(3)	Deep Sea Diver	3.689	2.035
(4)	Crane	5.351	1.899
(5)	Radio-active Laboratory	4.351	2.454
(6)	Horse Racing	3.797	2.042
(7)	Child on Rope	3.568	2.236
(8)	Window Cleaner	5.626	2.374
(9)	Scientist in the Arctic	4.270	2.342
(10)	Man on Rope	5.833	2.109
(11)	Nuclear Reactor	2.045	1.688
(12)	Steep Rock	6.104	2.187
(13)	Outer Space	6.437	2.325
(14)	Hanging Bridge	4.802	2.210
(15)	Skyscraper	7.468	1.822
(16)	Race Car	6.333	2.610
(17)	Sawyer	4.577	2.074
(18)	Tractor-harvester	2.631	2.042
(19)	Shunter	4.108	2.245
(20)	Yacht	3.550	2.135
(21)	Earthquake	3.419	2.470
(22)	Explosion	5.189	2.609
(23)	Forest Fire	5.387	2.394
(24)	War	8.198	1.476
(25)	Helicopter	5.324	2.262
(26)	Hang Gliding	5.977	2.207
(27)	Boat and Reactor	2.559	1.618
(28)	Log Transport	5.631	2.307
(29)	Inflatable Canoe	5.626	2.198
(30)	Parachutist	5.631	2.082

APPENDIX III: FACTOR MATRIX (TWO FACTORS/UNROTATED)

(1)	Crucible	.27494	-.44908
(2)	High-tension Mast	.32944	-.37985
(3)	Deep Sea Diver	.42609	-.35914
(4)	Crane	.31781	-.51186
(5)	Radio-active Laboratory	.28213	-.43257
(6)	Horse Racing	.44698	-.04502
(7)	Child on Rope	.29604	-.14727
(8)	Window Cleaner	.35012	-.22785
(9)	Scientist in the Arctic	.45222	-.17924
(10)	Man on Rope	.47337	.01172
(11)	Nuclear Reactor	.18263	-.33084
(12)	Steep Rock	.48876	.29590
(13)	Outer Space	.45386	.15347
(14)	Hanging Bridge	.48111	.20102
(15)	Skyscraper	.45705	-.09480
(16)	Race Car	.42151	.02015
(17)	Sawyer	.52707	-.00415
(18)	Tractor-harvester	.44946	-.07638
(19)	Shunter	.40463	.11726
(20)	Yacht	.54542	.18534
(21)	Earthquake	.39443	-.24561
(22)	Explosion	.35460	-.24788
(23)	Forest Fire	.54448	.20025
(24)	War	.20355	.29739
(25)	Helicopter	.47480	.35875
(26)	Hang Gliding	.38567	.41843
(27)	Boat and Reactor	.40965	.05321
(28)	Log Transport	.31665	.05887
(29)	Inflatable Canoe	.54460	.30746
(30)	Parachutist	.43422	.12258



Appendix IV. Loading Values on two Principle Factors/Total Sample.

APPENDIX V: CALCULATION OF T-TESTS BETWEEN MALES AND FEMALES

(1)	Crucible	t = 2.35**
(2)	High-tension Mast	t = -1.89*
(3)	Deap Sea Diver	t = -1.07
(4)	Crane	t = 1.66*
(5)	Radio-active Laboratory	t = 0.23
(6)	Horse Racing	t = 0.20
(7)	Child on Rope	t = -3.68**
(8)	Window Cleaner	t = -3.69**
(9)	Scientist in the Arctic	t = -1.99*
(10)	Man on Rope	t = 0.49
(11)	Nuclear Reactor	t = 0.20
(12)	Steep Rock	t = -1.41
(13)	Outer Space	t = -0.93
(14)	Hanging Bridge	t = -1.03
(15)	Skyscraper	t = -3.29**
(16)	Race Car	t = 0.64
(17)	Sawyer	t = -0.18
(18)	Tractor-harvester	t = -2.47**
(19)	Shunter	t = 0.21
(20)	Yacht	t = 1.66*
(21)	Earthquake	t = -1.80*
(22)	Explosion	t = -4.95**
(23)	Forest Fire	t = 1.34
(24)	War	t = -1.23
(25)	Helicopter	t = -0.51
(26)	Hang Gliding	t = 3.47**
(27)	Boat and Reactor	t = 1.58
(28)	Log Transport	t = 2.72**
(29)	Inflatable Canoe	t = -0.97
(30)	Parachutist	t = -1.87*

$$\left.\begin{aligned} {}^{*}t_{0.95} &= 1.65 \\ {}^{**}t_{0.99} &= 2.34 \end{aligned}\right\} \quad df = 220$$

REFERENCES

Cohen, J. (1960), *Chance, Skill and Luck*, Penguin, Baltimore, Maryland.

Fried, E. (1970), *Active/Passive. The Crucial Psychological Dimension*, Grune and Stratton, New York and London.

Golant, S., and I. Burton (1969a), *Avoidance Response to the Risk Environment*, Natural Hazard Research Working Paper No. 6, Department of Geography, University of Toronto, Toronto.

Golant, S., and I. Burton (1969b), *The Meaning of a Hazard-Application of the Semantic Differential*, Natural Hazard Research Working Paper No. 7, Department of Geography, University of Toronto, Toronto.

Harman, H.H. (1960), *Modern Factor Analysis*, University of Chicago Press, Chicago.

Kogan, N., and M.A. Wallach (1967), *Risk Taking as a Function of the Situation, the Person and the Group*, Holt, Rinehart and Winston, New York.

Lamm, H., and N. Kogan (1970), Risk Taking in the Context of Intergroup Negotiation, *Journal of Experimental Social Psychology*, 6, 3, 351-363.

Lamm, H., E. Schaude, and G. Trommsdorff (1971), Risky Shift as a Function of Group Members' Value of Risk and Need for Approval, *Journal of Personality and Social Psychology*, 20, 3, 430-435.

Maderthaner, R., et al. (1976), *Perception of Technological Risks: The Effect of Confrontation*, RM-76-53, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Merz, F. (1963), *Individuelle Risikobereitschaft*, Bericht No. 4041, Europaeische Gemeinschaft fuer Kohle und Stahl, Luxenburg.

Otway, H.J., et al., (1975), *Avoidance Response to the Risk Environment: A Cross-cultural Comparison*, RR-75-14, International Institute for Applied Systems Analysis, Laxenburg, Austria.

Otway, H.J., and P.D. Pahner (1976), Risk Assessment, *Futures*, 8, 2, 122-134.

Rettig, S., and H.E. Rawson (1963), The Risk Hypothesis in Predictive Judgements of Unethical Behavior, *Journal of Abnormal and Social Psychology*, 66, 109-113.

Thurstone, L.L. (1967), *The Measurement of Values*, University of Chicago Press, Chicago.

Woodworth, R.S., and H. Schlosberg (1971), *Experimental Psychology*, Holt, Rinehart and Winston, New York.