SCIENCE FAIR PROJECT ADJUDICATION: A STUDY OF 3 JUDGES

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in

THE FACULTY OF GRADUATE STUDIES

(Department of Science Education)

We accept this thesis as conforming

to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

MARCH, 1987

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ABSTRACT

This study investigated what judges looked for in an experimental science fair project and how the judges conducted a judging conversation. Audio-recordings of three judges' conversations with the same student and an in depth interview with each judge provided the data base for this study. This data base provided insight into the judging task and revealed aspects that these judges felt were important in evaluating a science fair project.

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Acknowledgement

I thank Dr. R. W. Carlisle, chairman of my masters committee, for his assistance, guidance, and friendship which proved vital to the completion of this study. I could not have hoped for a better mentor to steer me around those obstacles that sometimes seemed insurmountable.

A special thanks to Dr. G. Erickson for his humour and creativity which assisted in the formulation of ideas and the approaches to the conduct of research.

The green tea provided by Mrs. Carlisle, the support of other graduate students, and the cooperation of Mrs. P. Leigh coordinator of science fairs in British Columbia was greatly appreciated.

Lastly, I thank my family and friends, especially my mother and Selina, for their patience through times which took me away from the warmth of their friendship. In particular, I thank my father, C. B. Kiddell, for his encouragement and assistance in proofreading this document.

Chapter 1

Historical

The first organized science fair in Canada was in 1959 in Winnipeg. Science fairs spread across the country until, in 1961, the Canadian Science Fairs Council was set up to coordinate science fair activities. The executive committee of the Canadian Science Fairs Council recommended, in 1966, that the name Youth Science Foundation of Canada be adopted to convey a more exact interpretation of the organizations activities. Science fairs have flourished under this new banner. A total of 25 fairs existed in 1966 prior to the incorporation of the Youth Science Foundation. By 1969, 30 regional science fairs were in operation (YSF, 1984).

In 1986 more than 79 regional fairs were affiliated with the Youth Science Foundation representing all ten provinces. The majority of these fairs involved school aged students (7-19 years). Participants were expected to have a table display, with the equipment used to collect their data; a final report, including hypothesis, method, summary of observations and conclusions; and a posterboard explanation (Youth Science Foundation, 1985). In addition, students prepared oral presentations about their project for the adjudicators. The adjudicators were adults, usually with some sort of science affiliation. Science teachers, scientists and science

supervisors in the school system typify the occupations of many of the adjudicators involved in these fairs. Adjudicators were expected to determine awards on the basis of pre-established judging criteria provided by the Youth Science Foundation (Y.S.F.). All regional science fairs in Canada were influenced by the Y.S.F. which organizes and hosts the C.W.S.F. each year. The active promotion of science fairs has been an important part of the Y.S.F. since it was incorporated in 1966.

The Great Debate

A debate among educators and scientists about the value of science fairs exists. Authors who favour science fairs stress the value of fairs in terms of increased interest in science, increased knowledge, social gains, understanding of the process of science learning in the classroom and improved public relations. Critics, on the other hand, claim the fairs "provide unsophisticated experimentation, promote unwholesome competitiveness, employ subjective and imprecise judging, involve students at too early an age, are too time consuming for the teacher, and require too much scientific knowledge on the part of the elementary teacher" (Speece, 1978).

The judging of a science fair seems to be one of the more contentious aspects of the debate about science fairs. Judges are expected to evaluate science projects fairly and objectively

according to pre-set criteria provided by the organizers. Yet projects that do not fit these pre-set criteria are in some instances rewarded by high marks as the judges believe they contain "good" science that the criteria are not designed to evaluate. Some authors (Smith, 1980, and Lagueux and Amols, 1986) have suggested there is a need for the judges to be more objective.

Delegates to the Canada Wide Science Fair (C.W.S.F.) in Calgary 1986 also raised concerns about the judging of science fairs. Each delegate represented one of the 79 regional science fairs in Canada. Concern over the judging at the C.W.S.F. resulted in a committee being formed by the Youth Science Foundation (Y.S.F.). The committee suggested that new methods of judging and therefore new judging criteria might have to be developed so that all projects might compete on an equal basis (Canada Wide Science Fair Discussion Paper, 1986).

Currently, the judging criteria provided by the Y.S.F. are intended to be used by the judges to assess the value of the projects. No published study, however, has described any part of the adjudication of science fairs. Therefore the value and use of the Y.S.F.'s judging criteria is not known but is thought to be important. Examining judging is important as such a study reveals practical implications for organizers, participants and judges. The V.S.F.'s organizing committee provided guidelines for students on how to organize their projects. These guidelines

included the Y.S.F.'s judging criteria which the judges were expected to follow as they adjudicated. Whether or not judges adhered to these criteria provided by the Y.S.F. was not known. As dissatisfaction with the current method of judging has been expressed (Canada Wide Science Fair Discussion Paper, 1986), a careful look at what judges do as they adjudicate an experimental science fair project seems appropriate.

As mentioned no researcher has studied judging of science fair projects, although much of the literature on science fairs expresses concern over the judges and the judging process. Perhaps researchers have considered the judging of science fair projects to be insignificant or too difficult to examine. Whatever the reason for the lack of research there remains the need to find out what judges look for and what they do as they adjudicate a science fair project. This research study focuses on the judging process.

The pilot study revealed that judges used themes or categories as they conversed with students at a science fair. These themes or categories which judges look for in a conversation e.g. originality, care of design, and parts of the experiment were called topics. This study was designed in part to compare the topics the judges used with the judging criteria provided by the Y.S.F. A description of what topics judges use therefore might have implications for the guidelines issued to judges and student. In this way, the process of judging was described so all people affiliated with the judging of science

fairs might use the information to institute any necessary changes to reduce the plethora of criticisms that surround the judging of science fair projects.

Statement of the Problem

This study was designed to describe how judges adjudicated one science fair project and to examine the utterances and reveal the topics they used as they adjudicated. The researcher believed a description of a judge's "style" would result. Specifically, the methods and techniques used by each judge as he or she conducted a conversation with a student about her project were described.

Statement of Hypotheses

In order to guide the present study the following hypotheses were examined:

Hypothesis 1 - The written summary and project backboards will be utilized in ranking the student's project.

Hypothesis 2 - The judges' conversations (interview) with a student will be important in ranking the student's project.

Hypothesis 3 - Judges will follow the criteria provided by the Youth Science Foundation, those used by the Vancouver (Lower Mainland Regional) Science Fair.

Hypothesis 4 - Judges' conversations with students will be similar to a teacher's conversation in the classroom and each judge will have a personal judging style.

Limitations of the Study

There are two major limitations of this study:

(1) This study was limited to the three judges of the Physical Sciences Category, Junior section of the Vancouver (Lower Mainland Regional) Science Fair (V.S.F.) located in Vancouver, British Columbia. The use of judges from only one category means care must be exercised when statements are made that are relevant to other science fairs or judges of other categories.

(2) Only one student who produced a high quality project in the Physical Sciences Category, Junior Section was a part of this study. The time constraint of the methodology did not allow for more than one student's conversations with the three judges to be examined. Care must be exercised when statements are made that are relevant to other science fair projects.

Definitions

Science Fairs are defined as those organized expositions, directly or indirectly sanctioned by the Youth Science Foundation, at which students present and are judged for scientific experiments that they have designed and/or conducted. Speece (1978) stated, " A modern science fair consists of an exposition... at which children in grades 1- 12 can present and be judged for scientific experiments or displays that they have designed and/or conducted."

Vancouver (Lower Mainland Regional) Science Fair (V.S.F.) - a science fair directly sponsored by the Youth Science Foundation. Projects are entered in three divisions according to school grade: Junior (Grade 6 and 7), Intermediate (Grade 8 and 9), and Senior (Grades 10, 11, and 12). Projects are not only placed into categories on the basis of grade level, but also on the basis of the subject covered. There are currently four subject categories in each of the grade divisions. These categories are (1) Life, (2) Physical, (3) Engineering, and (4) Computers. Winning projects are eligible to participate in the Canada Wide Science Fair (C.W.S.F.) held in a different Canadian city each year.

Categories - all students at the V.S.F. entered in 1 of 4 categories. These categories were decided on the basis of the subject matter of the science project. The four categories were physical sciences, life sciences, engineering, and computer science. In addition each category was divided into three different age sections: senior (high school), intermediate (junior high), and junior (elementary school).

Physical Sciences Category, Junior Section - one of the 12 categories at the V.S.F. The only project examined in this study was produced in this section.

Experimental Science Projects - those projects that involve the obtaining of data or information by means of experiments. This also includes projects that allow students to make interpretations and draw conclusions from data gained through observation or surveys.

Project Dimensions - the maximum amount of space allotted to each project as provided by the Y.S.F. The dimensions are: height (2 meters), width (1.2 meters), and depth (0.8 meters).

The Youth Science Foundation (Y.S.F.)- an organization that is pledged to develop any programs which will:

(a) assist the scientific and teaching professions in their active support of scientific progress and education among young people in Canada.

(b) coordinate extra-curricular activities of Canadian youth in science and technology.

(c) encourage young people in Canada to consider lifetime vocations in science and technology and to stimulate their minds to a better understanding of the role of these fields in national and international affairs.

Judging Criteria - the rules provided by the Y.S.F. and used by the Vancouver (Lower Mainland Regional) Science Fair. These rules are intended to be used by the judges to establish the quality of a science fair project.

Judging Conversation - is the verbal interaction between judge and student as the student's project is being adjudicated. Each student exhibitor at the V.S.F. was expected to prepare a brief oral presentation for each of the judges. In addition each judge asked questions and made several other types of utterances as they interacted with each student.

Topics - themes or categories which judges look for in a conversation e.g. originality, care of design, and parts of an experiment.

Utterances - as described in this study are the communication of thoughts and ideas as vocal sounds.

Request Sequences - the way in which the judges asked the student for information. How the judges interacted with the student when they asked for specific information. Requests for information were often negotiated over extended sequences.

Initiations - are utterances the function of which is to request a linguistic response (Sinclair and Coulthard, 1975).

Reinitiations - where an initiation is unsuccessful and the judge tries again to secure a satisfactory response (McTear, 1985).

Follow-ups or Feedback - to let a student know how well she or he has performed. Follow-ups may occur not only after a student response but also after a student's initiation.

Chapter 2

The purpose of this chapter is to provide a background to the study of how judges adjudicate one science fair project. Several issues provide the focii for this study. These include a description of the literature concerning science fairs, and a discussion of the research methods and theory underlying the study.

Literature Related to the Problem

Many authors have written on the subject of science fairs. While a few authors condemn science fairs the majority suggest methods of promoting a more successful science fair. Even those proponents of science fairs recognize problems and indicate areas which require improvement. The variety of problems associated with the judging of science fairs are presented below.

Paldy (1971) 'worried' about the competitive nature of science fairs. He believed the competitive aspects of science fairs discouraged cooperation "which was particularly unfortunate... for such interactions are among the most distinctive features of the scientific enterprise" (Paldy, 1971). Paldy's (1971) greatest criticism centered on the distinction between experimental and non-experimental projects that were often made part of the judging rules:

> Since most fairs are supposed to stress pure science (whatever that is), a child who puts together an interesting piece of apparatus or demonstration but who does not really perform an experiment... is at a significant disadvantage in terms of awards. (p. 427)

Smith (1980) was critical of the lack of "investigative projects" at science fairs. He believed the essence of science was only found in investigative projects that involved the student in critical thinking. The absence of investigative projects in science fairs he attributed to the lack of discussion or agreement before a science fair between teachers, students, and science fair judges as to the purposes of the endeavor and the criteria by which entries will be judged (Smith, 1980). In Smith's (1980) view " The most startling reason for the present emphasis on non-investigative projects is the orientation of the judges themselves, which causes them to. . . discourage investigative projects" (p. 39).

Hedges, Popp, and Robinson (1974) presented six recommendations to improve the quality of science fairs. They concluded, in reference to judging, that the criteria for a science fair should, reflect "the basic purposes, particularly the encouragement of scientific thinking... [the criteria] guide the student in selecting and organizing his project and the judge in evaluating it" (Hedges et al., 1974, p. 8), and ensure that:

> .....the judges agree in their understanding of the criteria and follow them as rigorously as possible. Otherwise a very neat, a very attractive, or a spectacular project may receive a higher rating than it deserves because of a judges particular bias. (Hedges et al., 1974, p. 8)

McBurney (1978) expressed concern about the nature of the judging of science fairs. He identified a number of problems: the judges did not have enough time for adjudication: the judges were not professionally qualified in science and content areas. McBurney (1978) suggested several ways in which the adjudication of science fair projects might be improved. Specifically he believed awards should be based on competition against a standard rather than competition against another student:

> This standard should be based on such criteria as the clarity and definition of the problem or hypothesis, integrity of the experimental design and investigative procedures, accuracy of data interpretation, and other scientific qualities. (McBurney, 1978, p. 420)

Riechard (1976) thought that "the vast majority of science fairs are competitive in nature" (p. 257). The judging at science fairs was considered to be crucial to the overall success of the science fair (Riechard, 1976). Several suggestions were made by the author to improve judging. He recommended that science fair committees should (1) ensure that the rating criteria are understood by the judges, (2) establish different rating criteria for different types of projects, and (3) elaborate on the objectives and purposes of the fair for the

judges. Riechard (1976) felt that these suggestions would "minimize the most common judging error - the case where projects are rated relative to the judges' own individual philosophies of what a fair's purpose should be" (p.257).

All the literature described expresses concern about the judging of science fair projects but it is based on personal experience rather than research as no research has been published on the judging of science fairs in North America.

Speece (1979) and Subotnik (1984) were two researchers who examined science fairs. These authors researched science fairs as they were interested in informal science settings but they did not examine or describe the judges or the judging process at science fairs. The study was designed specifically to determine what judges looked for as they adjudicated the same science fair project and so address a missing component in a field as yet poorly researched.

Context of the Study-- Regional Concerns

In May, 1986, at a meeting of delegates from all the regional science fairs in Canada concern was expressed that the Y.S.F.'s judging criteria were not appropriate for the judging of certain types of science fair projects. Several delegates commented that the current judging criteria could only be used to adjudicate experimental projects. The concern was that several

science projects particularly those that conducted astronomical or anthropological investigation could not be adjudicated with the same criteria as the experimental projects. At least 50% of the delegates thought that astronomical or anthropological science fair projects should be accepted for science fairs but thought that the Y.S.F.'s judging criteria should be reviewed and altered so that all areas of science could be adjudicated fairly. Other delegations opposed this view, as they shared the belief that for a project to be scientific it must be experimental.

Therefore a motion was passed by all the delegates present that a committee be formed to examine the judging criteria currently used by the Y.S.F. The mandate of this committee was to recommend changes to the judging form, criteria and method of judging to reflect the concerns of various delegations from across Canada. If these recommendations were accepted there is likely to be impact on judges and the judging process.

A Review of Methods Used in the Study

Of all the areas looked at in the literature the one area that seemed most pressing was the judging of science fairs. No description of judges and how they adjudicate exists in the literature. Therefore it was decided to review the literature in order to outline the methods used in the study. described in this section. However, the actual methods used are described in Chapter 3. This literature was divided into three areas: stimulated recall, the nature of the conversation between judge and student, and the origins of the method for charting the judge's conversation with each student.

Stimulated Recall

Stimulated recall is a research tool that was first pioneered by Bloom in the early 1950's. Since that time the use of stimulated recall has proliferated but has not been used widely in naturalistic settings (Tuckwell, 1980). Bloom (1953) describes the basic idea of stimulated recall as one in which "...a subject may be enabled to relive an original situation with vividness and accuracy if he is presented with a large number of cues which occurred during the original situation". Under these circumstances the individual is a participant in an event at one time and is a subject reporting his conscious thought participation after the event (Bloom, 1954).

The technique of stimulated recall is based on the assumption that subjects are able and willing to recall and articulate their thought processes, and to do so as accurately and completely as possible (Tuckwell, 1980). An audio-tape of an event in which the subject participated may be replayed to assist in recalling the covert mental activity which accompanied the overt behaviour (Tuckwell, 1980).

Bloom (1953) found the subjects' ability to recall overt activities within 48 hours had a 95% accuracy. Gaier (1954) states the accuracy of recall of overt events dropped from 94% after two days to 65% after sixteen days. The replay of the audiotape and the provision of other stimuli such as photographs and transcripts apparently must be done as soon after the original event as is possible.

The pilot study confirmed that the interview the judge had with the researcher must be as close in time as possible to the original event. The judge's recall of the "overt checkable activities", and the accuracy of the recall of "conscious experience" demonstrated that the judge remembered clearly even seemingly insignificant details about his conversations with the students.

The pilot study also demonstrated that a complete transcript of a judge's conversation with a student was essential to stimulate the judge's recall. Detailed photographs of the students with their projects were also necessary. The photographs aided the judge's ability to recognize and remember the student and the project.

The pilot study and the literature indicate that stimulated recall is a viable heuristic. Therefore, stimulated recall has considerable potential in this study of how judges conversed with a student about her science project. Tuckwell (1980) states those who have used stimulated recall procedures have reported "positively on its value, commenting that it has proved promising and that it has yielded rich, interesting data".

A Formal Conversation

An important component of any conversation is that the participants engage in "turn-taking". Without turns conversation does not take place (McTear, 1985). McTear (1985) believed there was more to conversation than a series of turns. He believed there were ways in which speakers related their turns topically and "show[ed] links between and within turns" (McTear, 1985, p. 29). The discourse between judge and student at a science fair was a conversation because there was turn-taking, links between turns and linguistic content.

The judge's conversation with a student was a "formal" conversation. Formal conversations are those "in which the persons taking part have allocated positions" (McHoul, 1978, p. 185). Teachers have the right to "stand facing the class or to move around the class at will while no others had such rights" (McHoul, 1978, p. 185). Judges are also able to position themselves while the students have little choice but to stand. In this study the judges sat while the students stood for the duration of the judging conversation. That the judges sat where they chose was just one indication that judges dominate the conversation with elementary school students. The judge in a judging conversation has the "maximized participation rights" referred to by McHoul (1978).

However, there were differences in the type of conversations a judge, as opposed to a teacher, has with a student. The judge only deals with one student at a time and the judge is not responsible for the behavior of other individuals. The judge need not, as a result, be concerned about external noise and influence. Judges may focus solely on the student and the student's project.

Both the student and the judge, as they are the only participants in the conversation, ensure the conversation progresses. The conversation if it does falter may only be continued by either the judge or student. In a classroom

situation dealing with a poor response to a question may be avoided by directing the same question to a different student. The judge and the student do not have the same luxury. A concerted effort must be made by the judges to eliminate unimportant or wasteful utterances in the judging conversation.

Conversations in the classroom between teacher and student, and at the science fair between judge and student have considerable academic content. Stimulated recall is an appropriate method to study judges mental activities and what they look for as stimulated recall is a viable means of studying the covert mental activities of teachers (Marland, 1977). Formal talk is found both in classrooms and in the judging of science fairs. "Only teachers can direct speakership in any creative way" (p. 188) in the classroom situation according to McHoul (1978). And only the judges as they adjudicate at a science fair can control the turns of each participant in the judging conversation.

Unique Features of a Judging Conversation

Sacks, Shegloff and Jefferson (1974) state that the length of both formal and informal conversations is not specified in advance. Judging conversations at a science fair typically differ in that a time constraint is imposed. Judges have a maximum of twenty minutes to adjudicate each student at the V.S.F. The awareness of a time limit is one factor that makes a

judging conversation different from the conversations described by Sacks et al. (1974).

Another difference in the judging conversation is the use of models and backboards. These visual stimuli are used by both the judges and the students in their conversations. Students and judges are not totally dependent on their ability to verbally communicate as they have visual "props" in the form of a display which they can use.

The previous discussion has developed the idea that judges have conversations with students. While there are unique features it is evident that judges and students still partake in the one crucial element of a conversation and that is turn taking. Therefore the tools of conversation analysis were thought appropriate and essential to analyse the nature of a judge's conversation with a student.

Analyzing the Judging Conversations

The judges' conversations with a student as they adjudicate a science fair project can be analyzed using the tools of conversation analysis. Sacks, Shegloff, and Jefferson (1974) made an important contribution to the "understanding of the processes of conversational interaction, particularly regarding the 'work' which participants in conversations accomplish".

The researcher looked specifically at the utterances the judge made in conversation with the student.

McTear (1985) in his study of children's conversations found that individuals linked together requests, the responses they received, and other related material over extended sequences. McTear (1985) argued that it was "important to go beyond a description of requests as isolated speech acts to a consideration of their function in the context of the sequences in which they occur". The pilot study revealed many of the judges utterances in conversation with the student related to one another. On those occasions where a judge's utterances were linked together they were called request sequences (McTear, 1985).

A conversation "usually covers a number of topics and involves shifts from one topic to another" (Wardhaugh, 1985). He found it almost "impossible" to provide a narrow technical definition for the term 'topic':

> Usually, the kinds of topics we discuss in conversations are by no means well defined; in fact, the participants generally have to figure out what it is everyone is willing to talk about, and that very act of talking about what they perceive to be the topic helps to define it. (Wardhaugh, 1985, p. 139)

The utterances participants make in a conversation will cluster, and "the focus of that cluster is a topic" (Wardhaugh, 1985, p. 139). Sinclair and Coulthard (1975) from their data base of conversations found it possible to identify topics.

The transcripts of the judging conversations revealed each judge used different types of utterances. The judges used questions, statements, or one word utterances in their conversation with the student. The judges used these utterances in different ways depending on what information they sought from the student. McTear (1985) found questions and statements were used in conversations with children to initiate or reinitiate. Initiations were those utterances which opened conversational exchanges. Reinitiations were utterances used by the speaker as he or she tried again to secure a satisfactory response (McTear, 1985). Sinclair and Coulthard (1975) in their system of analysis found utterances could also be used to follow-up on a topic. A follow-up indicated the value of a contribution from a student usually in terms of relevance to the discourse. In this study follow-ups were considered an important part of the judge's conversation with each student. These three categories initiation, reinitiation, and follow-up were useful in describing how judges conversed with one student at the V.S.F.

No one graphical system for representing the system of analysis could be found that incorporated the terms initiation, reinitiation, and follow-up. As a result it was necessary for

the researcher to develop his own graphical system based on the conversational work of McTear (1985), Sinclair and Coulthard (1975), and Wardhaugh (1985) and the flow chart devised by Schoeneberg (1981).

Summary

Two areas that relate to the judging of science fairs were identified in the literature and in discussion among the delegates to the C.W.S.F. The examination of the literature on science fairs revealed that while much concern was expressed about the judging process little research has been conducted on this topic. about the science criteria and the judging procedures has surfaced at the national level in Canada. These together suggest the need for a study of what judge's look for as they adjudicate a science fair project.

The methodology used in this study was based on stimulated recall as described by Tuckwell (1980). To test if stimulated recall would be viable in the context of a judging conversation a pilot study was conducted.

The tools of conversation analysis were appropriate to study judges conversations. The terms initiation, reinitiation, and follow-up were components of a judges conversation. A need for a system for analysing a judging conversation was shown to exist as no appropriate system of analysis existed in the literature.

Chapter 3

The main purpose of this investigation was to determine what judges looked for when they adjudicated an experimental science fair project. The 1986 Vancouver (Lower Mainland Regional) Science Fair (V.S.F.) was chosen as the site of data collection. The V.S.F. is 1 of 79 regional science fairs affiliated with the Youth Science Foundation. across Canada. Chapter 3 presents the research methodology used in this study and is organized into the following sections: subjects used in the study, research design, chart of the judging conversation, and topics used by judges in their judging conversation.

Subject Selection

In the spring of 1986 the V.S.F was one of 79 regional science fairs formed across Canada under the guidance of the Youth Science Foundation (Y.S.F.). The V.S.F. used the judging criteria, the categories, and the project dimensions suggested and supplied by the Y.S.F. All science projects presented at the Vancouver Lower Mainland region were eligible to enter the V.S.F. Permission was obtained from the organizing committee of the V.S.F. to conduct this study, and to contact judges and students in the physical sciences category, junior section.

The judges at the V.S.F. were grouped on the basis of their professional background in units of three e.g. three physicists judged the physical sciences, junior category. Each group of judges was responsible for adjudicating 8 - 12 projects usually within the same science category and age section. All 3 judges in this study were physicists. Although these 3 judges decided on their final ranking of a project in consultation with other members of the judging group each judge's conversation with a student was conducted on an individual basis. This 15 minute conversation between judge and student was called the "judging conversation".

The pilot study affected the selection of judges for the research project. The highly ranked science projects at the elementary level during the pilot related to physics. These highly ranked projects were also perceived by the organizers and judges to represent "good" science. Highly ranked physical science projects were more likely to be produced by elementary school students than experimental projects in other categories according to the judge interviewed in the pilot study. Therefore, the 3 judges of the physical sciences category, junior section were selected to be the judges chosen for this study.

Requests to participate in the study were sent to the home addresses of the three judges. All three judges agreed to participate in the study. Permission was obtained to make audio recordings of each judge's conversation with the 11 students who

had projects in the physical sciences category junior section. Each judge also agreed to participate in a one hour audio-taped interview with the researcher within five days of completion of the judging at the science fair. Each judge agreed to this format.

The three judges were employed in jobs that require knowledge of the physical science area but each had a different professional and scientific background. Judge A was a professional science educator, an astronomer, in the Faculty of Education of a major university. She instructed computer programming and the teaching of high school physics. Judge B was a professional physicist. Judge B's research in the area of astrophysics gave him a particular view of science and scientific research. Judge C was a high school physics teacher. He taught at an all female school located in Vancouver.

The Chief judge, who was responsible for the allocation of judges at the V.S.F., intentionally arranged these three physicists to adjudicate the physical science category, junior section. The 3 judges were considered competent to adjudicate this category as the projects were all based in a scientific area with which each judge was familiar. After adjudication was completed the Chief judge commented that the physical science category, junior section was particularly well judged.

Although the subjects of this study were the judges the students were also audio-taped. The context of each judging conversation depended on both the judge's and student's utterances. Therefore, to gain permission for the audio-taping of students all 11 entrants in the physical science category, junior section received letters that sought student and parental permission to participate in the study. The consent forms were returned with both parental and student signatures. This ensured the researcher would have audio-tapes of the judges conversations with the students who produced the best projects.

Only the best student project, as decided by the judges, in the physical science category, junior section was used in this study. Audio-tapes of all the judging conversations in the physical science category, junior section were conducted to ensure that a recording was obtained of the adjudication of the `best' project. It was intended to use all 3 judging conversations with the student who produced the first placed project as the data base for this study. However, one of the three judging conversations with the student who produced the first placed project abruptly ended, the result of a tape recorder failure. Therefore, the three judging conversations with the second placed student's project on "The Insulating Qualities of Different Fabrics used for Clothing (Insulation)" was used instead. (Appendix A contains a complete description of the project).

RESEARCH DESIGN

Each judge met with the researcher prior to the science fair to be briefed on the use of the micro-cassette tape recorder. The results from the pilot showed that the microphones in these small audio recorders worked best if they were hand held when the judge was standing, or placed between the judge and the student when the judge was sitting. As the judges were provided with chairs the majority of the judging conversations had the student standing while the judge was seated.

The V.S.F. allocated the judges a minimum of 15 minutes and a maximum of 20 minutes for each judging conversation. Additional time was provided prior to the judging conversations for the judges to view the projects without the presence of any students. Time was also allotted after the judging conversations. This additional time allowed the judges to look again at projects which they felt required further adjudication. Upon completion of this adjudication period the judges consulted with each other in order to rank the best three projects in this category.

Only the audio-tapes of the judge's conversations with the student who produced the second placed project on "Insulation" were used in this study. A total of three judging conversations were transcribed. Several photographs were taken of this student's project and these were used to remind the judge of the

project during the interview each judge had with the researcher later in the week. The interview was used to verify specific components of each judge's conversation which were identified earlier by the researcher. Specifically the interview protocol was designed to confirm topics each judge used in his or her conversation with the student who produced the project on "Insulation". The interview protocol consisted of three sections. The first section was designed to gain general information on how each judge adjudicated the projects in the physical science category, junior section. The main purpose of this section though was to help judges remember their conversations with the student who produced the project on "Insulation". Detailed photographs of the student and her project on "Insulation" were shown to each of the three judges at the start of the interview. The photographs aided the judge's memory of the student and the project. A short section of the audio-taped judging conversation was played in this section for the same reason. Detailed questions were asked about the judging conversation only when it was clear the judge remembered the adjudication of the student project on "Insulation".

The second section of the interview protocol was designed to probe each judge about the request sequences that appeared in his or her conversation with the student. Request sequences each have a topic to which they are related (McTear, 1985). Each judge was asked to explain what he or she was looking for in specific parts of his or her conversation with the student. The

judges were able to distinguish what they were thinking at the time of their judging from what they thought at the time of the interview. The majority of prompts by the researcher in the interview were used to confirm the topics used by each judge.

The third section of the interview provided an opportunity for the judge to reflect on his judgment of the project on "Insulation" and to confirm the topic of each request sequence. The topic of each request sequence was presented to the judge at the conclusion of the interview in the form of a topic list. In addition, each judge was asked several questions designed to gain further insight into the judging process. A copy of the interview protocol developed for Judge B is located in Appendix D.

Judge A and Judge B were interviewed by the researcher on the third day after the adjudication of the projects while Judge C had his hour long interview on the fourth day. The interview with each judge by the researcher confirmed the topics of each request sequence the judges used in the judging conversation. The interview also served to identify parts of the project and areas of the judging conversation which enabled the judges to rank the project on "Insulation" in second place. The use of photographs, transcripts and a brief portion of the audio-tape of the judging conversation assisted the judges in their recall of the conversation they had with the student.

Prompts in the form of questions and statements were used to elicit from judges descriptions of how they adjudicated the project on "Insulation". Each judge was probed for the topics which determined that "Insulation" was a good project, as well as for explanations of specific parts of their judging conversation with the student exhibitor. The topics used were identified by the researcher through listening to the audiotapes and reading the transcripts of the judging conversation. Each hour long interview included the same prompts in the same order except where specific parts of the judge's conversation served as the source of the questions. The three interviews between judge and researcher were audio-taped and transcribed. The transcripts of these three interviews were crucial for the researcher to establish a clearer understanding of the judge's conversation with the student.

Analysis of Data

Each of the judge's utterances was identified from the transcript of each judge's conversation with the student. The judge's utterances in each conversation were coded and placed in a chart according to whether they were questions, statements, one word utterances, initiations, reinitiations, or follow-ups. From this chart topics were identified that were thought to be important to each judge. The value of coding utterances has been

well established by linguists like McTear (1985) and Sinclair and Coulthard (1975).

The utterances by the judges were first identified as initiations, reinitiations, or follow-ups. Utterances which set up expectations for responses were placed in the initiation column. McTear (1985) identified the different types of initiations which speakers commonly use:

> Some utterances are more clearly initiating than others. Requests for information and action demand responses, for example. Other utterances, such as statements, frequently only provide for the possibility of further talk but do not necessarily constrain the addressee to a particular response type. (p.)

Reinitiations occurred when either no response or an unsatisfactory response was received (McTear, 1985). Reinitiations also indicated that a response was sought and that its absence was "noticeable" (Sacks, 1968). McTear (1985) found that reinitiations were usually not simple repetitions. Speakers changed their prosodic patterns, attention getting words and vocatives to make a reinitiation more likely to succeed. Rephrasings and paraphrasings of the original initiation were therefore identified as reinitiations. The pilot study revealed reinitiations were used in the judging conversations with each student.

Utterances which related to a preceeding initiation or reinitiation were classified as follow-ups. Follow-ups serve a:

> function ...to let the pupil know how well he or she has performed. It is very significant that follow-up occurs not only after a pupil answering move, but also after a pupil opening move... In other words the teacher often indicates the value of an unelicited contribution from a pupil, usually in terms of relevance to the discourse (Sinclair and Coulthard, 1975).

Utterances were also classified as "student led" or "judge led". Utterances that were student led show the judge followed a student's initiation. The converse was true when the judge led.

McTear (1985) argued that it was important to go beyond a description of "isolated speech acts to a consideration of their function in the context of the sequences in which they occur". As a result McTear (1985) identified "request sequences" as "sequences of interaction initiated by a request for action". Each request sequence in any conversation has a topic or theme to which it is related (McTear, 1985). Topics for each request sequence in a judging conversation were identified by the researcher by listening to the audio-tapes, reading the transcripts, and examining the charts of each judge's conversation with the student. The topics used in each judge's conversation were the basis for developing the interview protocol for each judge.

The way the judges interacted with the student in the judging conversation was referred to as their "style". The judging style of each judge was determined by the number of initiations, reinitiations, and follow-ups, the number of questions, statements, and one word utterances, and by the number and type of each request sequence used in conversation with the student who produced the project on "Insulation". An attempt to validate each judge's style was also an important part of the interview with each judge.

From the interview with each judge the topics used in each judging conversation seemed to be an important part of the adjudication of the student's project. Therefore, these topics were compared and contrasted with the judging criteria provided by the Y.S.F.

Summary

Data was collected to gain greater insight into the adjudication of experimental science fair projects. Three judges' conversations with one student project were audio-taped and transcribed. On the basis of each judge's conversation with this student an interview protocol was designed to (1) verify the topics used, (2) identify the important parts of a project, and (3) establish if the criteria provided by the Youth Science Foundation were used. Each judge's interview with the researcher was audio-taped and transcribed.

Each judge's conversation with the student was charted. An analysis of these charts reveal the topics, initiations, reinitiations, follow-ups, questions, statements, and one word utterances used by each judge. These utterances enabled the researcher to tentatively describe the style of each judge.

Chapter 4

Introduction

What judges looked for in a science project and how they determined the science content of a project was the focus of this study. The most direct method would have been to ask the judges what topics they looked for as they adjudicated a science project, and how they determined whether these topics existed. However, when asking judges why they adjudicated projects in a certain way one encounters three difficulties. First, in answering the question the judge may only give those topics which "spring-to-mind". Topics which are equally important, may not immediately be thought of. Second, the judges may reconstruct their topics for making a judgment in an interview and thus report different topics than those actually used in a judging conversation. This reconstruction arises when judges describe their perception of an event as compared to their description of what actually took place. Thirdly, judges may not be able to express in words some features of a "judging conversation". It is hypothesized that a tacit dimension to judging exists that is not readily available to recall or memory.

In light of these difficulties it was not an appropriate procedure to ask judges what they do when they adjudicate science fair projects. So, the original judging conversations of the three judges with the one student were audio-taped and subsequently transcribed. In an interview with the researcher

the judges were requested to reflect on their actions in relation to specific portions of the transcript (See Appendix E for a transcript of the interview of Judge B with the researcher). Thus, the methodology of stimulated recall as described by Tuckwell (1980) was used to produce the data described in this chapter.

Request Sequences

Each judge conducted a conversation with the student who presented a project on "Insulation" (See Appendix C). For the purposes of simplicity and clarity each judging conversation was set out graphically in the form of a flow chart (see Figures 4:1, 4:2, and 4:3) adapted from a decision making model developed by Spradley (1972). Each judge's utterances, questions, statements, and exclamations were coded and placed in a chart according to their content and purpose.

In the flow charts, each circle indicates the utterance was a question. Questions were those utterances intended to gain more information from the student and were identified from the judge's inflection as well as the content of the utterance. Statements are depicted as hatched squares in the flow charts. Statements were primarily comments and therefore were not intended to elicit responses from the students. The last type of utterance coded were the one word utterances. "Mmm-mm", "Right",

KEY FOR FIGURES 4:1,4:2, AND 4:3

 = QUESTION

 = STATEMENT

 = A COMMENT USED TO ENCOURAGE THE STUDENT TO CONTINUE TO TALK.

 = LINKS TOGETHER SIMILAR UTTERANCES BY THE JUDGE. (JUDGE INITIATED UTTERANCES)

 = INDICATES THAT THE JUDGE FOLLOWS THE STUDENT'S UTTERANCE. (STUDENT INITIATED UTTERANCES)

THE NUMBER INSIDE A SHAPE IS THE UTTERANCE NUMBER E.G.

 INDICATES UTTERANCE # 12

FIGURE 4:1 - REQUEST SEQUENCES OF JUDGE A

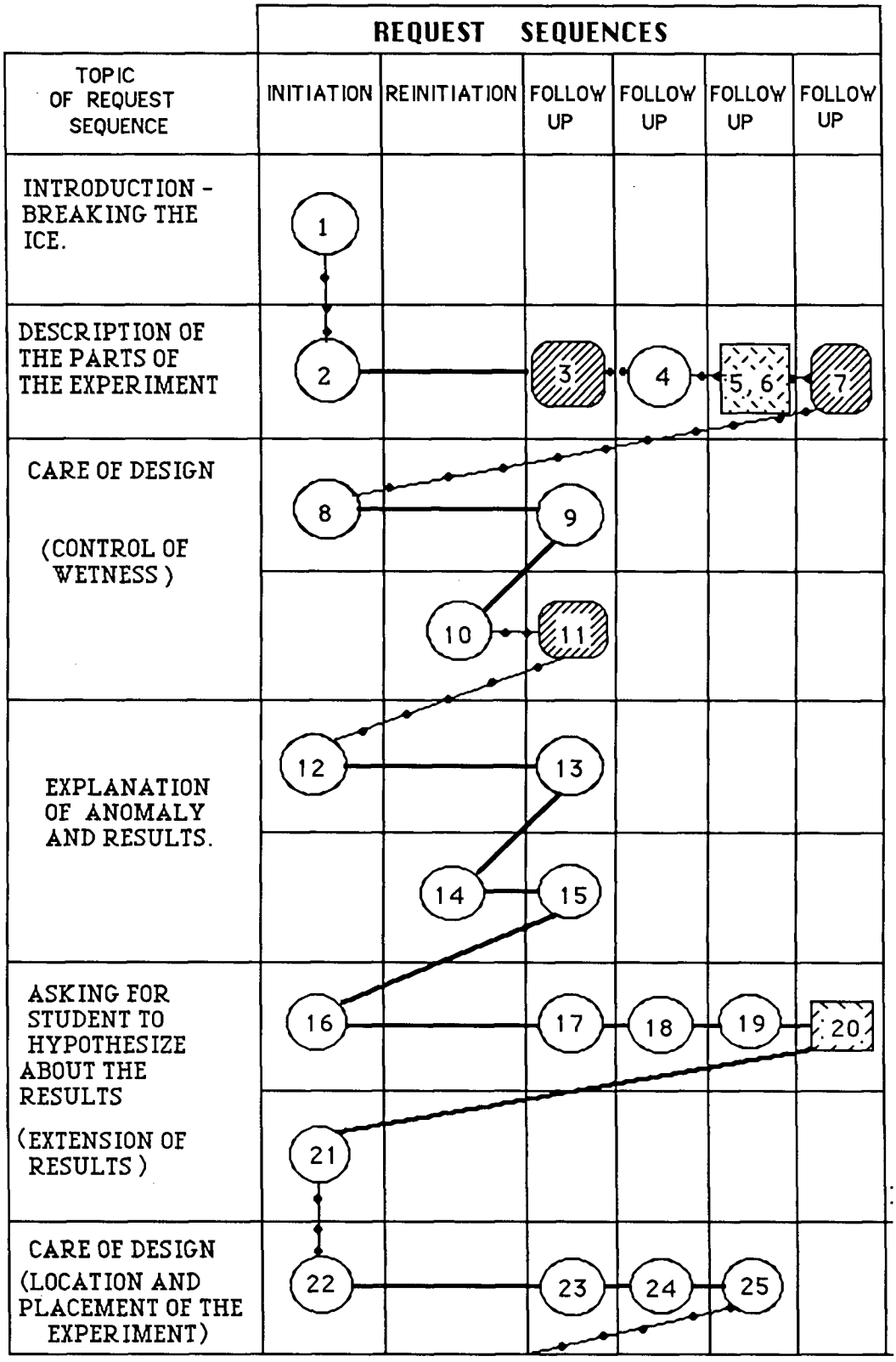


FIGURE 4:1 - REQUEST SEQUENCES OF JUDGE A (CONTINUED)

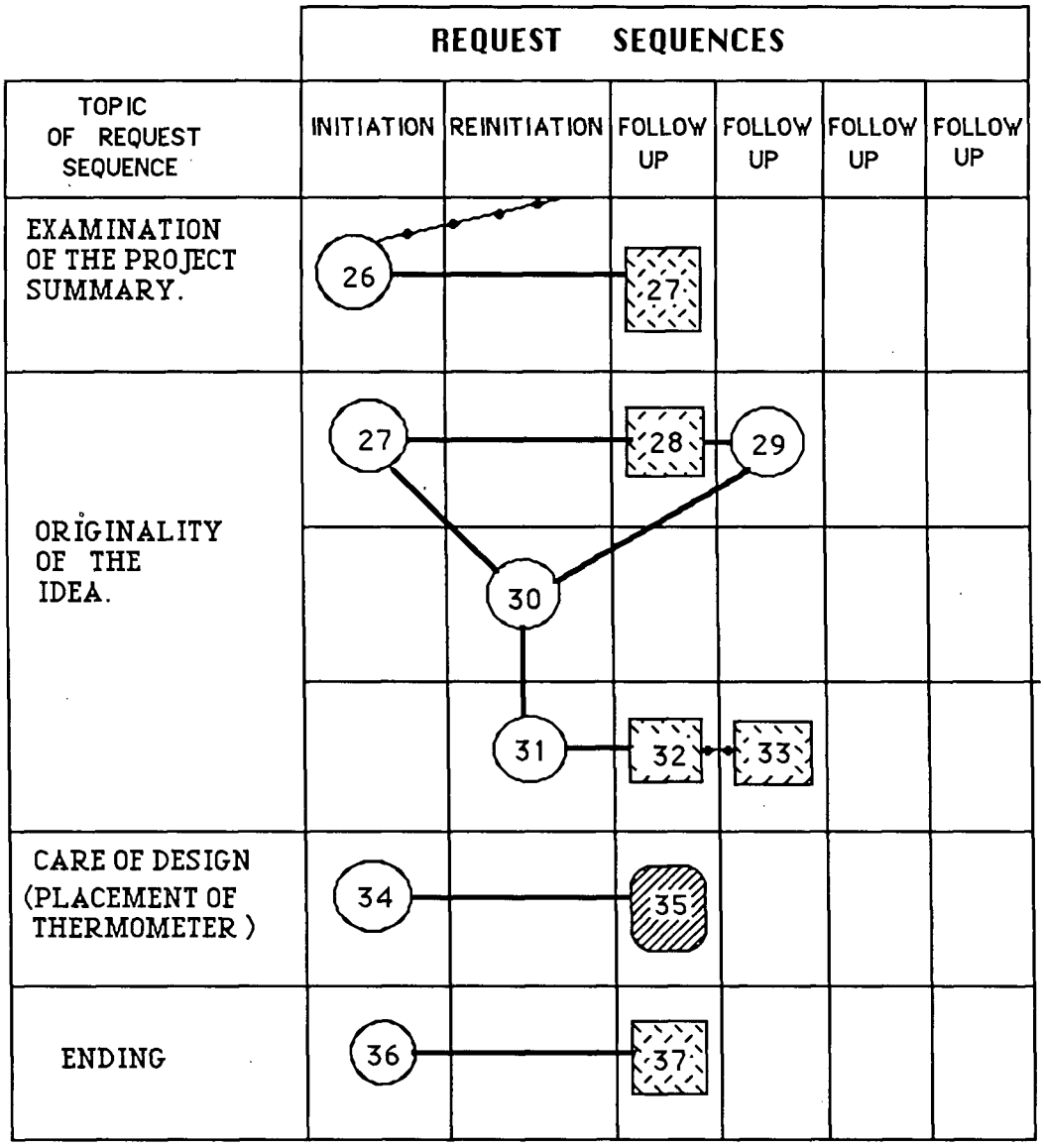


FIGURE 4:2 - REQUEST SEQUENCES OF JUDGE B

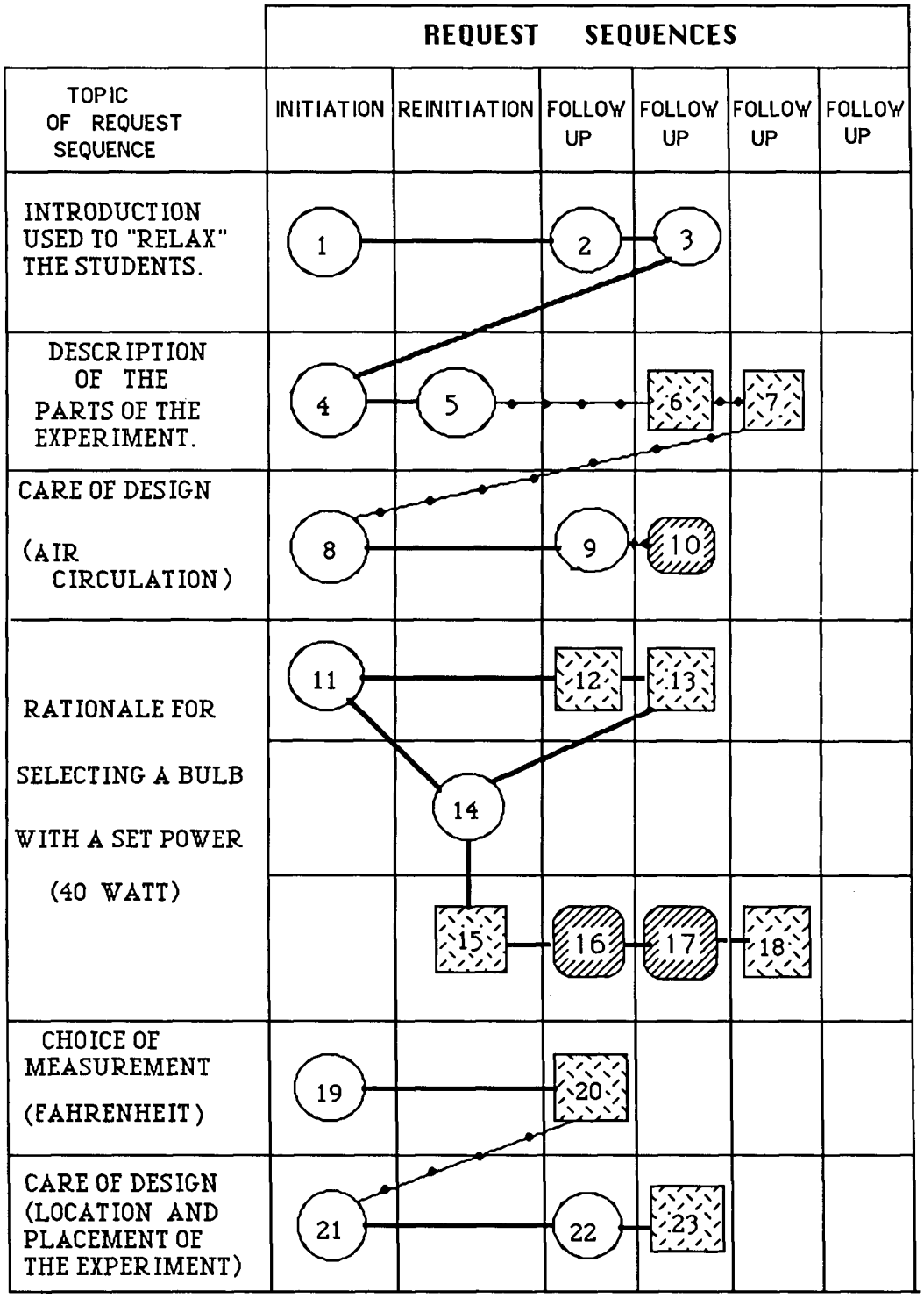


FIGURE 4:2 - REQUEST SEQUENCES OF JUDGE B (CONTINUED)

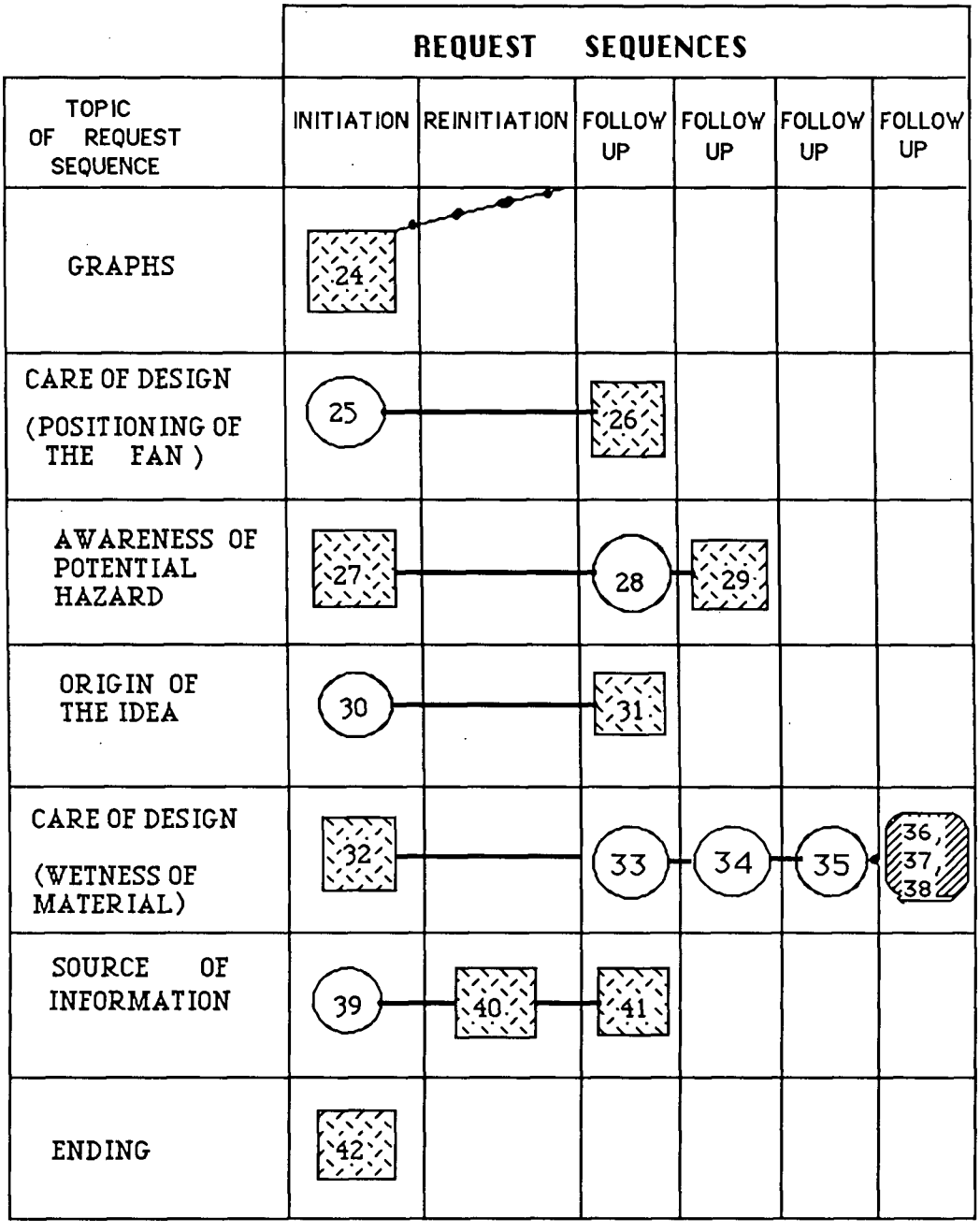


FIGURE 4:3 - REQUEST SEQUENCES OF JUDGE C

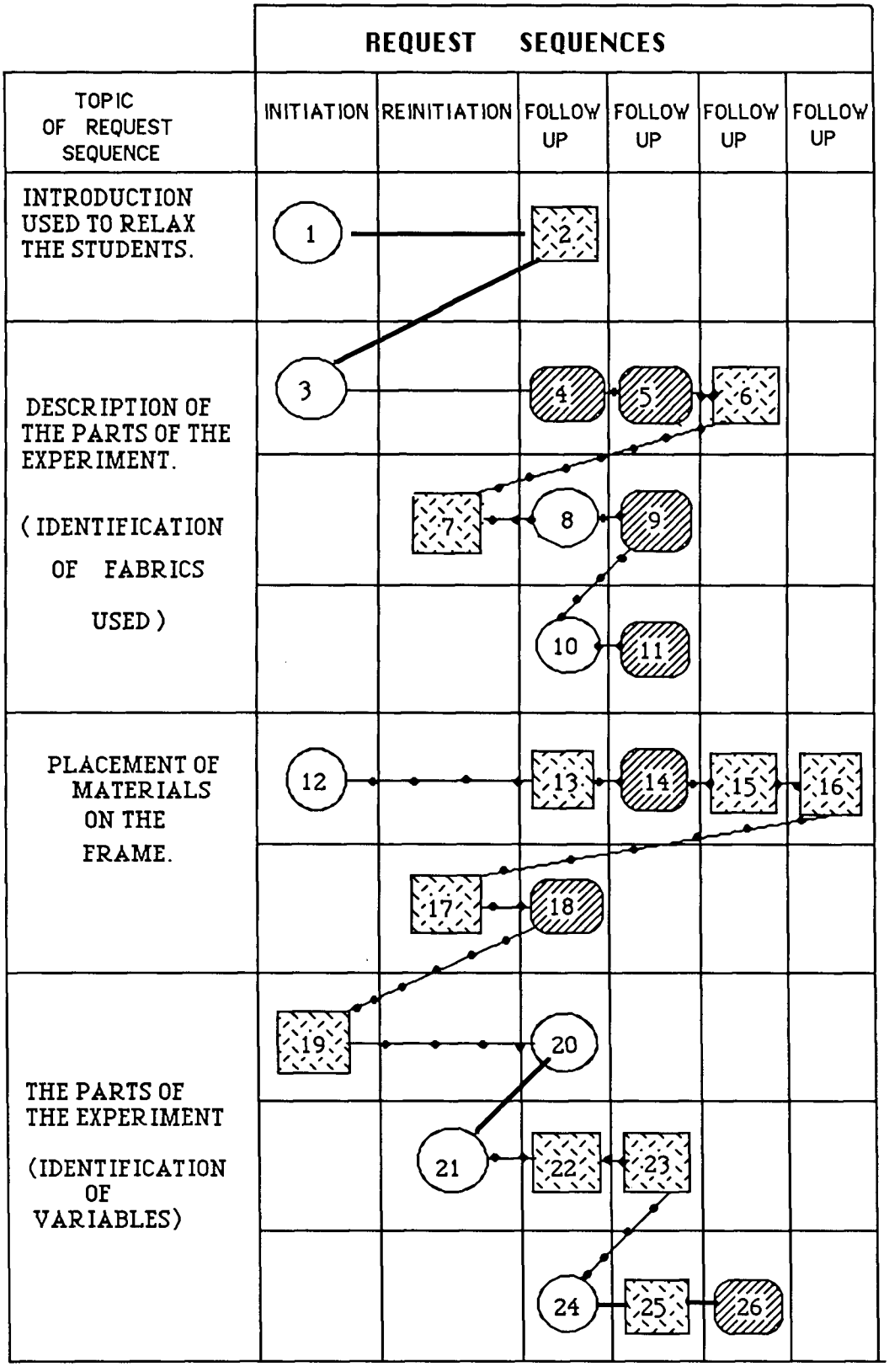


FIGURE 4:3 - REQUEST SEQUENCES OF JUDGE C (CONTINUED)

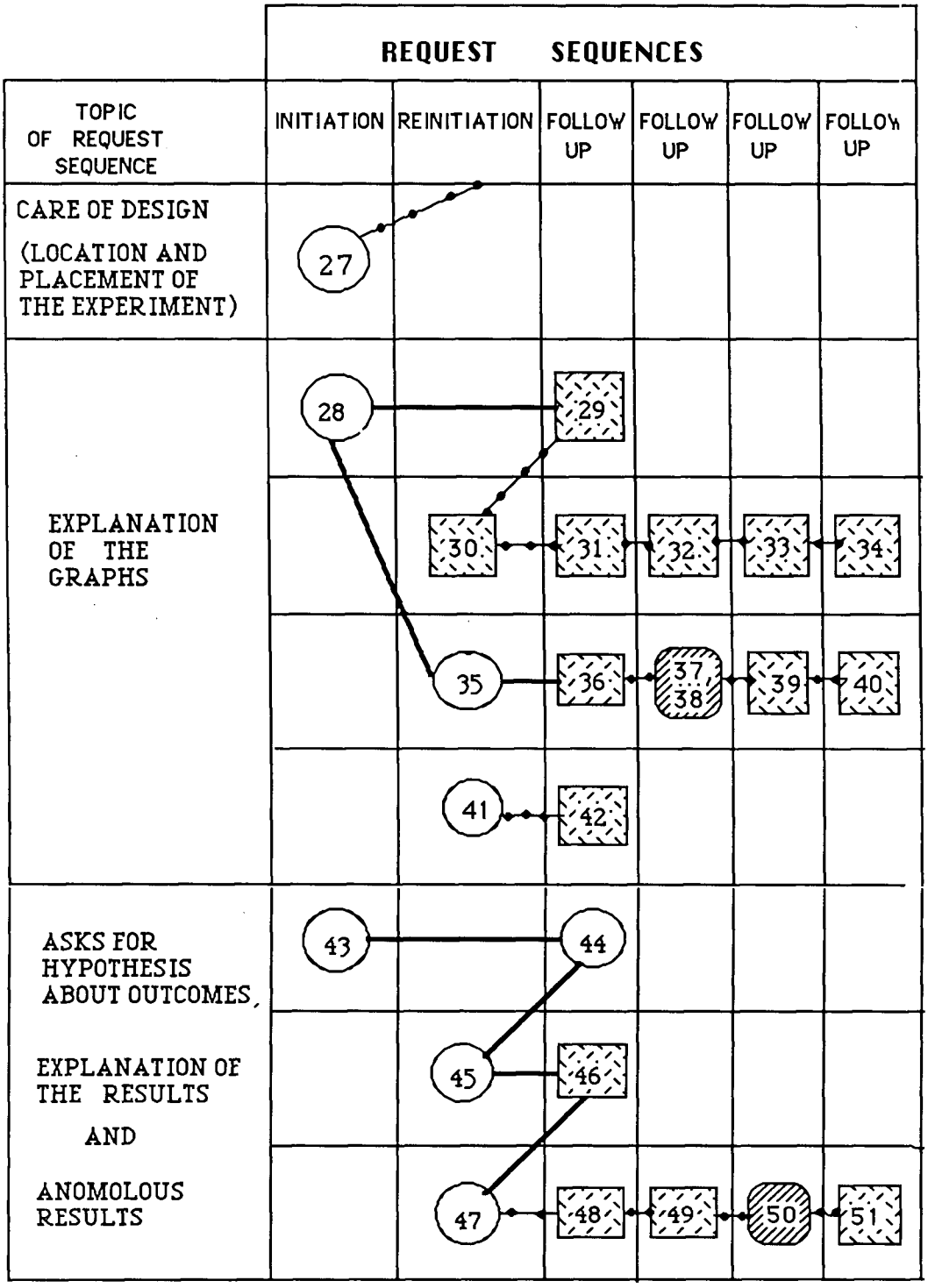
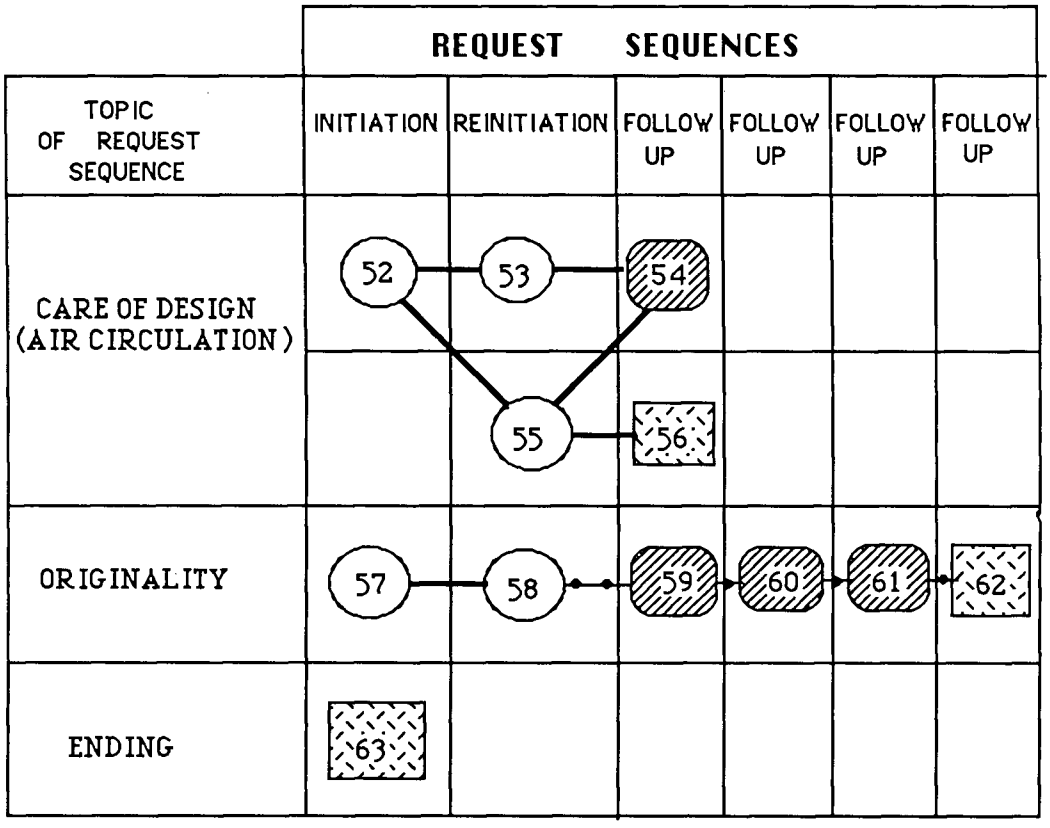


FIGURE 4:3 - REQUEST SEQUENCES OF JUDGE C (CONTINUED)



"Yes" are examples of one word utterances. These utterances appear in the charts as 'squares' with rounded edges. All the judge's utterances were numbered. For example, the first utterance was numbered with a "1", the second utterance was numbered with a "2" and so on.

The coded utterances were classified as "initiations", "reinitiations", or "follow-ups". Initiations were attention directing utterances and were always found at the start of a request sequence (McTear, 1985). Reinitiations occured where the judge tried to secure again a satisfactory response. Reinitiations mainly occured when the original initiation was ignored or misunderstood (McTear, 1985). Follow-ups were utterances that requested data or an explanation of the same topic as the original initiation. Lines between utterances indicate the utterances are either student or judge led. For example, Judge A asked a question about the originality of the project and the student responded with a reference to the graphs. The judge then asked a question about the graphs. The last question by the judge in this sequence is therefore student led.

The flow charts illustrate utterances which are on the same topic. These topics are referred to by McTear (1985) as "request sequences". Whenever judges initiated a new topic the researcher considered a new request sequence had begun. The left hand column of the flow charts contains the topic of each request sequence. Figures 4:1, 4:2, and 4:3 showed that each judging

conversation consisted of several request sequences. However, utterances used to introduce or conclude the conversation were not considered as request sequences. A closer look at these charts revealed similarities and differences among the three judges.

A Comparison of the Flow Charts

The audio-tapes of each judge's conversation with the student when they were first listened to suggested each judge had conducted the conversation in an unstructured manner. To determine if any order in fact existed within this apparent chaos, all the utterances were coded. The information was placed in flow charts (Figures 4:1, 4:2, and 4:3) as described in the previous section. Even though the flow charts were a more presentable form of the judging conversations some features of each judge's conversations were not apparent. Therefore, the numbers and types of utterances were tabulated so that each judge's utterances could be readily compared.

Table 1 and 2 summarize the data derived from a tally of individual flow charts. Table 1 shows the percentage of initiations, reinitiations, follow-ups, and request sequences of each judging conversation for all three judges. Table 2 shows the percentage of questions, statements, one word utterances, and

Table 1

Judges Initiations, Reinitiations, Follow-ups, and Request Sequences

Judge	Total Utterances (Number)	Initiations	Reinitiations	Follow ups	Request Sequences (Number)
A	37	30% (11)	11% (4)	59% (22)	9
B	42	31% (13)	10% (4)	60% (25)	11
C	63	16% (10)	16% (10)	68% (43)	8

Table 2

Judges Questions, Statements, and One Word Utterances

Judge	Total Utterances (Number)	Questions	Statements	One Word Utterances	% of Occasions Judge Led	% of Occasions Student Led
A	37	70% (26)	19% (7)	11% (4)	82%	18%
B	42	45% (19)	40% (17)	14% (6)	87%	13%
C	63	33% (21)	46% (28)	21% (14)	41%	59%

occasions where the student leads for all three judges. The data provide the researcher with a basis to attempt to identify "styles" used by the judges in the judging conversations.

Table 1 indicates that the judges varied in the number of utterances made in their judging conversations with the student. Judge A and B had a similar number of utterances and a similar percentage of initiations, reinitiations, and follow ups in their judging conversations. Judge C used 70% more utterances than Judge A. The majority of these additional utterances by Judge C were in the form of follow-ups or reinitiations. Judge C, though, made 13% fewer initiations than either of the other judges. All three judging conversations consisted of approximately 10 request sequences. Therefore, each judge focussed on a similar number of topics.

The data from Table 1 may be used to suggest a similarity between Judge A and B that is not so apparent when we look at Table 2. All three judges in this table use a different proportion of questions to statements. Judge A, for example, uses questions far more frequently than either Judge B or C. Another difference is the percentage of occasions on which the student led the conversation. In conversation with Judge C the student led more than half of the conversation. However, the student led in the conversation with Judge A and B on less than 20% of the utterances.

Confirmation of the Topic of Each Request Sequence

The content of the left hand column in Figures 4:1, 4:2 and 4:3 summarizes the topic being examined by the judges' utterances. In most instances the topic of the request sequences were identified by carefully listening to the audio-tape and reading the transcript of each judging conversation. To ensure that the topics were correctly identified the judges were asked to confirm the topic of each request sequence in the interview with the researcher.

The topics of each request sequence enabled each judge to examine areas of the project in which they were interested. The judges made similar statements about the importance of the judging conversation:

> Judge B - The interview ...is the most important [part of the project]. I tend to judge the participant more than the exhibit. ...if the participant is knowledgeable about the exhibit, that is important.

Therefore, the way the student conversed about each topic of the judging conversation were helpful to the judges in ranking the project. The topics the judges used were important in assessing the value of a project.

Tables 3, 4, and 5 list the topics identified in each request sequence by the 3 judges. Alongside the topics are comments from the judges that occurred in the interview. These

comments illustrate how the judge was conscious of the topics used in their judging conversation.

Topics common to each judging conversation (Table 3) were the "parts of the experiment", "originality of the project", and "care of design". Judge A and C referred to "care of design" as "controlling the experiment". Judge B, in the interview stated, that he did not believe in controls or controlling experiments:

> There's been somebody trying to write a recipe for doing science and it always seems to involve controlled experiments ...I think control is one that relates [to] having some standard to which things are compared ...I've got to evaluate what was done on its own merits and not by some external person's norm.

Judge B referred to controls under the broader category of "care of design". Both Judge A and C used the topic of "controls" to identify some of their request sequences. These judges explained in the interview what was meant by "controls". It was clear that the "controls" Judge A and C referred to fall neatly into the category of "care of design". "Care of design" was the only topic that required such careful interpretation. All the other topics were identified by the judges from their use of common terms.

Table 3

Expression of Topics by Judge A

Topic	Judge A's Confirmation
Did the student describe and explain the parts of the experiment?	I like students to describe their project to see if they can identify what the problem was.
Has care of design been shown? (wetness of material)	She should control the amount of water going into the fabric.
(location and placement of experiment)	We got into the idea again of controls...about the temperature of the room when she did [the experiment].
(placement of thermometer)	I was asking about how she had controlled where the thermometer was in her apparatus.
(air circulation)	
(placement of materials on frame)	
Did the student explain anomolous results?	I was trying to get her to explain in what way it was strange...did it go against her hypothesis?
Did the student explain the purpose and function of the graphs?	
Were the results clear? Did the student extend the results? Do the results agree with the hypothesis?	Had she set up a hypothesis...was there a connection between the hypothesis and the results. Did her results suggest an extension? Something else related to [the results] that might allow [the student] to go on.

Table 3 (Continued)
Expression of Topics by Judge A

Topic	Judge A's Confirmation
Project summary	I think the written report is important.
Originality	Had she done it, how much of her work was into it. Where did the project idea come from?
Selection of Bulb	
Choice of measurement (Fahrenheit)	
Awareness of potential hazards	

Table 4

Expression of Topics by Judge B

Topic	Judge B's Confirmation
Did the student describe and explain the parts of the experiment?	I wanted really to cut right to the science.
Has care of design been shown? (wetness of material)	The water was evaporating all the time [was the student aware of] steady state.
(location and placement of experiment)	This is convection again ...The [experiments] should be done in some sort of standard condition ..."The fan just sort of sat like it is now?"
(placement of thermometer)	
(air circulation)	It is important to distinguish convection from conduction... How did she make sure there was no air getting out?
(placement of materials on frame)	
Did the student explain anomolous results?	She had done something wrong.
Did the student explain the purpose and function of the graphs?	She had no reason for what she had done [with her graphs] which was not right. She had done something wrong...There was no way she was going to justify that.
Were the results clear? Did the student extend the results? Do the results agree with the hypothesis?	

Table 4 (Continued)

Expression of Topics by Judge B

Topic	Judge B's Confirmation
Project summary	I didn't read any of these things.
Originality	I'm always interested in the sources of information.
Selection of Bulb	I was wondering how hot things would get.
Choice of measurement (Fahrenheit)	The higher precision measurement could be done in Fahrenheit.
Awareness of potential hazards	She should have had an adults help because you sure can hurt yourself.

Table 5

Expression of Topics by Judge C

Topic	Judge C's Confirmation
Did the student describe and explain the parts of the experiment?	She is telling me in order what she did... I'm really learning about the experiment.
Has care of design been shown? (wetness of material)	
(location and placement of experiment)	Had she used a constant external situation... had she attempted to control the external.
(placement of thermometer)	
(air circulation)	I had finally seen the potential for her to have some real flawing in what she had done. A sweater wouldn't have wrapped the whole thing as well as a coat.
(placement of materials on frame)	How were the materials placed on the frame and why did she place them this way?
Did the student explain anomolous results?	I think she was probably a little confused herself.
Did the student explain the purpose and function of the graphs?	What did her graphs show? Did she know what information was on her graphs.
Were the results clear? Did the student extend the results? Do the results agree with the hypothesis?	What were the conclusions of the experiment... this is the really interesting part of the experiment or one in which the experimenter has a good opportunity to show understanding.

Expression of Topics by Judge C (Continued)

Topic	Judge C's Confirmation
Project summary	I don't even recall seeing her written report.
Originality	What made her think to do the project... It is important to determine if the project is their own work.
Selection of Bulb	
Choice of measurement (Fahrenheit)	
Awareness of potential hazards	

Only 3 of the 10 topics were common to all three judges. Table 3, 4, and 5 reveal that a description of the parts of the experiment, the originality of the project, and the care of design exhibited by students are topics used by each judge. The parts of the experiment was asked about by each judge in order to help understand the student's project. The originality of the project was also important to each judge:

> Judge A -One of the things that [I try to do] is to ascertain to some degree at any rate, how much work they did in putting the equipment together and how much help they have had.

The topic for care of design was not interpreted by each judge in the same way. Judge A for example was concerned about the placement of the thermometer in the apparatus while neither Judge B or C mentioned this as a component of care of design.

No other topics were used by all three judges. However, the topics were important enough to be used in at least one request sequence. Judge A and C, for example, mentioned they were interested in results that were anomolous or "strange". In addition Judge A was the only adjudicator to ascribe any importance to the skill demonstrated in the written summary.

Judge B and C initiated request sequences on the graphs. Both judges were interested in the relationship between the x-axis and y-axis as shown on the graphs. Only a few of Judge B's

utterances were on this topic. Judge C used a greater percentage of utterances on the graphs than on any other topic except for the parts of the experiment.

Judge B searched for three topics for which none of the other judges looked: the "selection of the bulb", "choice of measurement", and "awareness of potential hazards". This judge felt the student should be able to explain why a 40 Watt bulb was selected and why the measurement was in Fahrenheit. Judge B also expressed concern that the student performed an experiment that entailed the wrapping of wet materials around an electrical fixture:

> ...if I had my kid draping wet clothes on things I would insist that any volt stuff [electrical parts] be well insulated. This was a little bit raggedy. That is one thing that did impress me about her exhibit ...it looked like she had done it.

Table 3, 4, and 5 list the topics used in each judging conversation with the student. A comparison of these tables reveals each judge used approximately 10 topics to determine the final placement of a project. Each judge used different topics in their judging conversations. This combination of what judges did and said provided the researcher with a basis for identifying each judge's "style".

Judge's Order of Topics

The judges used a number of topics as they adjudicated. Accordingly, an examination of the order of the topics and the emphasis placed on each topic is appropriate. Table 6 illustrates the order in which the topics were examined in the judging conversation. The topics are numbered 1 - 10. Interestingly, all 3 judges questioned the student on the "parts of the experiment" as their first topic. And were interested in some aspect of the "care of design" as their second topic. So all three judges started off their judging conversations in a similar way. In the middle of each judging conversation the judges look at the results, graphs, and once again at the "care of design". Near the conclusion of the judging conversations each judge questioned the student on the originality of the project.

There were also differences in the order in which each judge used the topics in the judging conversation. Judge A was concerned about the soaking of the material near the beginning of the judging conversation. In Judge B's conversation this topic, under the broader heading of care of design was not brought up until the conversation was nearly over. Both Judge B and C initiated request sequences on "air circulation". "Air circulation" was the first topic that Judge B looked for while it was the next to last topic searched for by Judge C.

Table 6

Judge's Order of Topics

Topic	Order topic searched Judge A	Judge B	Judge C
Did the student describe and explain the parts of the experiment?	1	1	1,3
Has care of design been shown? (wetness of material)	2	10	--
(location and placement of experiment)	6	5	4
(position of the fan)	--	7	--
(placement of thermometer)	9	--	--
(air circulation)	--	2	7
(placement of materials on frame)	--	--	2
Did the student explain anomolous results?	3	--	6
Did the student explain the purpose and function of the graphs?	--	6	5
Did the student explain the results? (Did the student explain the link between the hypothesis and the results?)	4	--	6
(Could the student extend the results?)	5	--	--
Project summary	7	--	--
Originality (Quantity of assistance from adults)	8	9	8
(Sources of Information)		11	
Selection of Bulb	--	3	--
Choice of measurement (Fahrenheit)	--	4	--
Awareness of potential hazards	--	8	--

The sequence used to search for topics by each judge was held in a general way but the judges did not have a predetermined format:

> Judge C -...there was a format overall. It wasn't anything I consciously worked out but ...I think I probably followed [a] sequence ...It's the same classic things that are really involved in any lab report ...,the same sequence.

Judges' Emphasis on each Topic

Table 7 shows the percentage of utterances for each of the 10 topics. This table illustrates the emphasis placed on any topic by the three judges. Through a comparison of the percentage of utterances the researcher found out how judges vary in their use of topics.

The 3 judges as mentioned previously shared three common topics. Table 7 shows the average of the percentages of utterances used by each judge on these common topics. The average percentage of utterances on "parts of the experiment" was 18%, "care of design", 28%, and "originality", 14%. Therefore 60% of the utterances by the judges are on only three topics. A high percentage suggests a heavy emphasis was placed on these three topics by the 3 judges.

Both Judge A and B used topics that were not used by either of the two other judges. Judge A as well as being the only judge to look at the placement of the thermometer in "care of design" was the only judge to be interested in the project summary:

> Judge A - I have the feeling that getting the students to write the thing [report] out themselves in full detail, after they have done some kind of a project, helps to clarify the ideas for them.

Judge B initiated a request sequence about the position of the fan which was considered as "care of design". He was the only judge to mention the sources of information as one aspect of "originality". However, three topics unique to Judge B were the "selection of the bulb", "choice of measurement", and the student's "awareness of potential hazards". The first two topics could come under "care of design" and the last as a part of "originality". However, Judge B stressed these topics in such a way that they were considered as separate and distinct topics.

Judge C was concerned with how the materials had been placed on the frame. This topic was placed as a feature of "care of design" based on the comments made by the judge during the interview.

Table 7
Judges' Emphasis on Each Topic

Topic	Utterances by Judge A	Judge B	Judge C	AVE
Did the student describe and explain the parts of the experiment?	16%	10%	27%	18%
Has care of design been shown? (wetness of material)	11%	17%	--	
(location and placement of experiment)	11%	7%	1%	
(position of the fan)	--	5%	--	
(placement of thermometer)	5%	--	--	
(air circulation)	--	7%	8%	
(placement of materials on frame)	--	--	11%	
TOTAL	27%	36%	20%	28%
Did the student explain anomolous results?	11%	--	3%	
Did the student explain the purpose and function of the graphs?	--	2%	24%	
Did the student explain the results? (Did the student explain the link between the hypothesis and the results?)	14%	--	11%	
(Could the student extend the results?)	3%	--	--	
Project summary	5%	--	--	
Originality (Quantity of assistance from adults)	19%	5%	10%	
(Sources of information)	--	7%	--	
TOTAL	19%	12%	10%	14%

Table 7
Judges' Emphasis on Each Topic (Continued)

Topic	Utterances by Judge A	Judge B	Judge C	AVE
Selection of Bulb	--	19%	--	
Choice of measurement (Fahrenheit)	--	5%	--	
Awareness of potential hazards	--	7%	--	
Introductory and concluding utterances	8%	10%	5%	8%

A few topics or aspects of each topic were used by only two judges. Judge A and B, for example, shared only one request sequence on the "wetness of the material". 8% of all utterances made by Judge B and C were on the topic of air circulation. They were also the only judges to look at the purpose and function of the graphs.

The nature of each judge's conversation was determined by an analysis of the flow charts (Figure 4:1, 4:2, and 4:3) and by looking at the utterances and topics of each request sequence (Tables 1 to 7). The order and emphasis placed on each topic allowed the researcher to search for a "style" for each judge. The topics determined from an examination of the judging conversations and confirmed in an interview with each judge were then compared to the science criteria provided by the Y.S.F.

Youth Science Foundation Criteria versus the Judge's Topics

The Y.S.F. provided the judging criteria to be used by the three judges. Five sections scientific thought, originality, skill, creative ability and dramatic value comprise the Y.S.F.'s judging criteria (Appendix B). However, for the purpose of this study the topics used by the judges were compared only with the criteria contained in the scientific thought section shown in Table 8. There are three reasons for concentrating on the scientific thought section. First, the science content of a project is contained mainly in this section. Second, the judges

found the other four sections unimportant in assessing scientific content. Third, the Y.S.F. criteria contained in the sections on skill, creative ability, and dramatic value were not used by the judges. Only in the `originality' section was there any common ground between the topics used by the judges and the criteria dictated by the Y.S.F.

Table 8 shows the criteria from the scientific thought section of the Y.S.F.'s judging criteria. A "yes" in the judge's column indicates the judge used a topic similar to the criterion provided by the Y.S.F. A "no" means the Y.S.F. criterion was not used by that judge nor did the judge use a topic similar to the criterion.

The topics used by each judge and the judging criteria of the Y.S.F. were rarely similar. The few criteria/topics that were similar shared only a few common characteristics. The first Y.S.F. criterion, for example, was about the hypothesis and how it reflected the background readings. Judge A and C had topics that fit in this category only because they were interested in the student's ability to hypothesize. No concern, though, was expressed by Judge A or C about how well the hypothesis reflected the student's readings, which was part of the Y.S.F.'s first criterion. Nevertheless, both judges were interested in the student's hypotheses so Table 8 shows each judge used the first criterion.

Table 8

Judge's use of the Y.S.F.'s Scientific Thought Criteria

Science Criteria used by the V.S.F. (Provided by the Y.S.F.)	Judge A	Judge B	Judge C
(1) The hypothesis was stated clearly and reflected the background readings.	YES	NO	YES
(2) There was an effective plan for obtaining a solution or answering a question.	NO	YES	NO
(3) The project carried out its purpose to completion within the scope of the original plan.	NO	NO	NO
(4) The project shows an understanding of existing knowledge, use of adequate scientific vocabulary and demonstrates an understanding of terms gleaned from reliable sources of information.	NO	NO	NO
(5) The experimental design demonstrated understanding of the scientific methods.	NO	NO	NO
(6) The student(s) has/have an idea of what further research is indicated by the project.	YES	NO	NO
(7) There are adequate data to support the conclusions. The experimental errors inherent in the measurement made and in the materials used were recognized.	YES	YES	YES
(8) The experiment was repeated several times to establish validity of results and/or statiscally validated.	NO	NO	NO
(9) The variables are clearly defined and recognized. If controls were necessary, there was a recognition of their need and they were correctly used.	YES	NO	YES

The sixth ("future research") and the ninth criteria ("variables and controls") provided by the Y.S.F. (Table 8) are similar to those of the "Care of Design" criteria used by Judge A and C. The sixth criterion of the scientific thought section provided by the Y.S.F. asked what idea the student had for further research. This criterion had the same purpose as Judge A's "could the student extend the results". Judge A, and Judge C, also expressed interest in the controls and variables used by the students. As explained previously variables and controls were classed as "Care of Design". "Care of design" was not related to the fifth Y.S.F. criterion of scientific methods because what was meant by scientific methods was not clear. Table 8 shows both the sixth and ninth criteria were similar to the topics used by each judge.

Judge B made no utterances on the student's data and results even though he was keenly interested that the student had a careful design from which conclusions could be reached. A good "Care of Design" and "explanation of results" was important to both Judge A and C. As a result the second and seventh criteria provided by the Y.S.F. also match the topics actually used by the judges.

The Y.S.F.'s fourth criterion concerned the use of scientific vocabulary. Judge B used one request sequence on the sources of information that seemed similar to the Y.S.F.'s fourth

criterion, the interview with Judge B revealed the request sequence was to do with originality and not an understanding of scientific terms. None of the judges, Table 8 shows, used the fourth criterion of the Y.S.F.

The remainder of the criteria provided by the Y.S.F. did not match the topics used by any of the three judges. No utterances or request sequences by any of the judges were concerned with "the scope of the original plan", "understanding of the scientific methods", or "repetition of the experiment to establish validity of the results". These Y.S.F. criteria (3), (5), and (8) were not used by any of the judges in their judging conversation with the student.

Table 8 shows the topics used by the three judges in their judging conversation with the student are different from the scientific thought criteria provided by the Y.S.F. A few of the judge's topics seemed similar to the Y.S.F.'s scientific thought criteria but even these were not identical. Judge A explained in the interview that she attempted to use the criteria provided by the Y.S.F. Neither Judge B nor Judge C attempted to use the judging criteria provided by the Y.S.F.:

> Judge C - What [I was] looking at didn't fit the criteria. Does the experiment do this ...or does the student do that weren't appropriate [criteria].

Statements by the Judges

In the interview each judge made several statements on the judging of science fairs. These statements were in addition to the remarks made on the specifics of the judging conversation. More evidence to explain and support each judge's "style" was provided from these responses. So, Table 9 contains the judge's responses to questions asked in the interview.

The interview protocol required the researcher to ask many of the same questions to each judge. Table 9 shows the questions asked of all 3 judges and the judge's responses. The response to these questions provided more information on the similarities and differences among the 3 judges.

Each judge's response to the first question (Table 9) is the only question where all three responses differed. Judge A placed the project on "Insulation" in second place in the Junior Physical Category partly because the student did an experiment and set up a hypothesis. Judge B gave the project a high ranking as the girl had done a "competent job". Judge C had a "feel ...for the whole group" and ranked the project on the basis of his "own criteria".

Table 9
Statements by the Judges

Question asked of each judge.	Judge's Statements
(1) How did you come to your judgement of this project?	Judge A - [This project] took a different approach [from many of the other projects] which was basically doing an experiment and setting up a hypothesis. Judge B - I thought this was a terribly competent job. If she had conceived it in all herself, done the experimental design, worried about all the details...she had certainly done a [remarkable] job. Judge C - I did not use the formal structure provided. I used my own gut feeling, okay? ...the number [of projects] I was looking at really allowed me to feel that I had the feel for the whole group. ...I was applying my own criteria, but not the paper structure provided.
(2) How important was the interview making up your mind?	Judge A - [The judging conversation] was very important. The information [should] come out in their verbal presentation. Judge B - The interview is the most important [part of the project]. I tend to judge the participant more than the exhibit. If the participant [is] involved with and interested in the exhibit, that is important. Judge C - The interview was important ...I don't even recall seeing her written report. ...the backboards don't do much for me.
(3) Did you preview the project?	Judge A - Yes I went around and looked at the 8 or so [projects] I was going to judge. I went and had a quick look ...then I went back and quickly read through their notes that we were given in their packages so I could have some idea what it was they were going to do. Judge B - No. I was in the welcoming ceremony.

Table 9
Statements by the Judges (Continued)

Question asked of each judge.	Judge's Statements
	Judge C - I strolled the aisle, but I really didn't look in detail.
(4) Were you comparing this project to other projects you have seen? Were these projects in the same category? (Looking for relative or absolute standards)	Judge A - Yes, eventually! Of course I did. But at this particular point, since she was my first student I wasn't really comparing. ...[I compare them] on the basis of the [projects] that we have got. I [don't] worry about previous years or anything. Judge B - No. I was only comparing the two actually. [The first two projects] were clearly better in my mind before I went through the judging dynamic with the other judges. ...These 8 projects were the only projects on my mind. Judge C - Yes. I judged them against one another. In the back of my mind there is some sort of external standard as well, I need to see something of quality there.
(5) Were you confirming a judgement or making a judgment?	Judge A - No [I was making a judgment], but I use the project notes in a sense to think about some of the kinds of questions I might ask [during the judging conversation]. Judge B - I think [I was making a judgment], because I think ...probably her exhibit was the most appealing if not the best. Judge C - I was making a judgment on the basis [of the judging conversation].

Table 9
Statements by the Judges (Continued)

Question asked of each judge.	Judge's Statements
(6) Were you using a pre set format for your questioning?	Judge A - No, I don't. I think I generally start off with, "Would you tell me about your project", or something as general as that to get them going. I do then try to follow their own leads--what they bring up. ...I do like to find out where the idea came from ...what the project problem was ...check the results, controls, and accuracy. Sometimes what are the extensions ...how would they apply it? Can they answer a "what if" question? Can they apply the information they have accumulated? ...I do try to follow their own conversation as much as possible so it is not an inquisition. Judge B - No, certainly not. ...I simply go in and say I'm going to interact with this kid and find out how good a kid this is. Remember I am judging a kid. The subject we're talking about is the exhibit at hand and that is a focus. Judge C - No I really didn't. Although, there was a format overall it wasn't anything I consciously worked out. But I know that in each case I think I probably followed a sequence: the student tried to describe the experiment ...I asked them about the results...and controls. It's the same classic things that are involved in any lab report really, the same sequence.
(7) Did you use the judging criteria provided by the organizers? Why/why not?	Judge A - Yes. They were the guidelines. I try to use the criteria [provided by the Y.S.F.] specified here, but I don't find it possible to put in a numerical mark beside each one. I can't do that. Judge B - No. I am unable to work with those [judging criteria]. I don't believe the kids will work to them and that was verified. You'll find the kids didn't pay any attention to those criteria at all and so I didn't use them. ...Objective criteria are very hard to come by.

Table 9
Statements by the Judges (Continued)

Question asked of each judge.	Judge's Statements
	Judge C - I might have tried to use them but I would have been frustrated because there is such differences in [the types of projects]. What we were looking at didn't fit the criteria.
(8) How do you view your judgement of the project now?	Judge A - I still think that where we put her was the appropriate place. We all thought these two [first and second] projects were the best. Judge B - I'm satisfied... we picked the top two right. Judge C - It is surprising that I felt as good about the project as I did and I think that the answer is I still like good science whether the organization is as clear as it might be. ...I think it was probably the right decision.

Judge A was the only judge to preview the exhibit and use the judging criteria provided by the Y.S.F. (Table 9, questions 3 and 7). Both Judge B and C believed there was little worth in previewing the exhibit and were adamant that the judging criteria provided were inappropriate. Even Judge A did not place a numerical mark beside the judging criteria. Little value was attached to the use of the Y.S.F.'s judging criteria or to the preview of the exhibit.

Each judge responded to all the other questions in a similar fashion. All judges thought the backboards and written material were of minimal importance compared to the interview in assessing the value of the student's project. The judges gave prime consideration to the results of the conversation with the student in coming to a final conclusion on the ranking of the project. This judgment was based solely on the 8 projects entered in the Junior Physical Category at the V.S.F. None of the judges compared this project to projects they had seen from other years. However, Judge B mentioned in the interview that the ranking of a project in his case might be affected if he had seen the same type of project at a previous science fair.

Table 9 also shows a pre-set format for questioning the student was not used by any of the judges. But both Judge A and C felt they probably followed a sequence for each project even though they were unaware the sequence existed. The sequence if it existed was unintentional and not consciously worked out

according to the judges. Judge B saw no sequence in his judging conversation and made clear all he did was to "interact" with the student.

All three judges were satisfied at the conclusion of the interview with their judgment of the project. They felt the top two projects were correctly picked.

Table 9 shows the judges had many similarities. The judges' use of the Y.S.F.'s judging criteria, the value of previewing the exhibit, the importance of the interview, and how they came to their judgment are a few of the topics to which each judge responded.

The "style" with which judges adjudicated the experimental science fair project, based on the data collected here, is examined. An analysis of the judges' "style" reveals the judges' perspective of judging and how they applied their understanding to the judging conversation.

A Description of Each Judge's Style

Upon completion of the judging conversations and interview it was clear considerable amounts of data had been collected which could be used to address the question of judging style. From these data the "styles" used by the judges as they interviewed the student were formulated.

Two of a Kind

Judge A and B had many similarities in their judging style. A close look at the data obtained from the judging conversations and interview with the two judges revealed these similarities.

Both Judge A and B had a similar percentage of initiations, reinitiations, follow-ups, and number of request sequences in their judging conversation with the same student. One third of the utterances by both judges were initiations. New request sequences began with an initiation so Judges A and B seemed more intent on initiating a topic than in following a topic. The average number of utterances in any request sequence was less than 5, showing that few utterances were made by either judge on any one topic. The brevity of the request sequences was a major characteristic of both Judge A's and Judge B's conversation.

Judge A and B looked for the same three topics in the same order. First, both judges began their judging conversations by asking the student to describe the "parts of the experiment". The judges next request sequence asked the students about the "care of design". At least 4 different topics were then pursued by each judge until late in the judging conversation when both judges asked about the "originality" of the project. The importance of these 3 topics was revealed by the frequency of utterances as revealed earlier in Table 7. 63% of Judge A's utterances and 58% of Judge B's utterances were on these three criteria. From these data and from the interview with Judge A and B the importance of these three criteria in evaluating a project was established. Therefore, the style of both judges consisted of a similar order and emphasis on criteria.

Another similarity between the judging conversations of Judge A and B was the very few occasions on which the student was allowed to lead. Less than 20% of all the utterances in each of these two judging conversations were student led. Another way of looking at this same aspect of the judging conversation was that Judge A and B led the judging conversation 80% of the time. Additionally, 7% of the student led utterances occurred in the first request sequence where the judges learned the parts of the experiment. Both judges suggested the best way for them to learn the parts of the project, as indicated in the interview with the researcher, was to have a verbal description by the student. Because Judge A and B led so much of the conversation they

determined what topics were initiated, and the duration of each request sequence.

Thus Judge A and B used a similar "style" of judging. The style was characterized by the high percentage of initiations and short length of each request sequence. Judge A and B's judging style consisted of at least 30% initiations, the student led less than 20% of the time, and each judge controlled the direction of the judging conversation. The particular style adopted by these judges depended on the dominance in the conversation of the judge over the student, hence, the researcher refers to Judge A and B's style as that of an "interrogator".

From statements made in the interview with the researcher both Judges A and B were conscious that their questions were designed to test the student's knowledge:

> Judge A - I do like to find out where the idea came from...[and]... check the results, check the controls, [and] check the accuracy. Sometimes, what are the extensions,... where would you go from there? How would you apply it?... see if they can answer a "what if question". Can they apply the information that they have accumulated? Questions of that sort."

Odd Man Out

Judge C did not have the same style as an "interrogator". Table 2 showed 46% of Judge C's utterances were statements and 33% were questions. A very different proportion of utterances from either of the other judges. Judge C's conversation is best distinguished from Judge A and B by the large number of occasions (59%) which the student led the conversation (See Table 2 and Figure 4:3). The preponderance of student initiated talk showed that Judge C was led by the student for the majority of the judging conversation. Judge C therefore seemed to have the style of a "follower". "Followers" hand the reins of control to the student at the beginning of the judging conversation and expect the student to lead for the duration or at least part of the judging conversation. Judge C was aware he intended the student should lead:

> ...a lot of the kids just turn on the tape recorder and away they go ...you could tell that they memorized a [speech]. ...For some reason or other she chopped and rambled. She didn't have that sort of set let it go kind of starting. ...I [still] wanted to hear her presentation, [though].

Judge C explained that he believed it was important for the students to discuss their project with the judge and to present it in their own way.

As Figure 4:3 shows, utterances #28 (explanation of the graphs), #43 (results), #52 (care of design), and #57 (originality) initiated four request sequences which were very different from the student led sequences at the beginning of the judging conversation. This pattern would suggest that Judge C allowed the student to lead the conversation initially but, as the judge confirmed in the interview, he eventually wanted the student to answer specific questions. Judge C explained why he initiated the four request sequences later in the judging conversation:

> I was conscious that this [was] really the good part of the experiment or one in which the experimenter [had] a good opportunity to show understanding. I mean there [were] certain points in some of these [conversations] where you [could] really apply a knife to see if the kid really [understood] the idea or not.

In these request sequences the style Judge C used was that of an "interrogator".

Judge C also emphasized 3 of the same criteria as Judge A and B (Table 7). A majority (57%) of Judge C's utterances were about the parts of the experiment, the care of design, and the originality of the project. As mentioned previously, over 50% of Judge A and B's utterances were on the same 3 topics. That the 3 judges emphasized the same topic and that they all asked specific questions showed Judge C's concerns were not idiosyncratic.

Judge A, B, and C made many similar statements in their interview with the researcher (Table 9). Judge C felt the judging conversation was "important" and helped him make up his mind. He also concurred with statements made by Judge A and B that he was comparing the project on "Insulation" to other projects in the same category, and that he was not using a pre-set format for questioning. Judge C shared many of the same ideas as Judge A and B and therefore used similar techniques in his judging conversation with the student.

Judge C, when he was the "follower", allowed the student to lead many parts of the judging conversation. However, he was an "interrogator" when he wanted to know if the student "really understood". Therefore, Judge C's style could be identified as that of a "style changer" i.e. The judge was able to adapt his style to fit the anticipated outcomes.

Although the student was adjudicated individually by each judge at least part of each judging conversation was conducted as an "interrogation". The style describes the nature of the judge's interaction with the student. The three styles "interrogator", "follower", and "style changer" were used by the 3 judges as they adjudicated the student's project.

Reflections on Styles

When other data are emphasized the 3 judging styles described may have been little more than "straws in the wind". even though the last section showed judges were all "interrogators" for at least part of their judging conversation. Judge A and B were very similar especially when compared and contrasted to Judge C. However, a closer examination of the differences between each judge revealed, with the exception of previously mentioned commonalities, that in fact each judge handled the judging conversation with the student project on "Insulation" in very different ways.

All three judges differed in the percentage of questions and statements used in the judging conversation with the student. Questions accounted for 70% of Judge A's utterances, 45% of Judge B's utterances, and only 33% of Judge C's utterances. Statements and one word utterances were a minimal part of the judging conversation as conducted by Judge A.

Judge A, therefore, did stick closely to the style of an "interrogator" throughout the conversation with the student. However, Judge A did not correct erroneous responses by the student for two reasons:

> One, if I am the first one through and I correct them ... the next two judges get the right answers! I don't think that is really appropriate. Two, they put a lot of work into [the project] and they are quite proud of it and if I start criticizing, [by saying] "Well, this is wrong...", I think that's kind of defeating.

Judge B and C used questions, statements and one word utterances in a way that was different from Judge A. These judges combined the different utterances as they encouraged the student to grapple with a difficult topic. For example, one request sequence in the judging conversation with Judge B centered on the evaporation of water from the material during the experiment:

STATEMENT	(32)J- Keeping conditions the same ...is very important in science so you always want to... realize what it is you are measuring. (pause) There is one thing that you might not have thought about. (pause) When the fabric was wet...(pause)
	S- Yes...
QUESTION	(33) ...the water was evaporating all the time?
	S- Yes. That is right.
QUESTION	(34) So the condition was really changing all the time?
	S- I guess it was... but since it was 20 minutes I didn't think that it would evaporate too much.
QUESTION	(35)J- No? It was still wet when you finished?
	S- Yes it was. It was still more or less the same.
ONE WORD UTTERANCE	(36)J- Yeh. Mmm-mm.
	S- But that was probably because it

was...

ONE WORD UTTERANCE

(37)J- So...

S- ...totally soaked it so that it was totally wet.

Judge B confirmed the purpose behind this sequence during the interview with the researcher:

> [I was wondering] if she [the student] had any speculations. I would have told her about steady state if she was inclined at all to go into it. You know, if she said, "I never thought about that?" or "what could do that?". If she would have asked a question, I would have answered.

From the student responses to the combination of different utterances, Judge B concluded the student did not have any speculations on the care of design criterion that concerned the wetness of the material.

Judge B and C are similar in one other way. Both judges add comments on a subject as exemplified by Judge B. One example of how Judge B disseminated information is found in utterance #15 of his judging conversation:

QUESTION

(14)J- How much power do you think your body gives off?

S- I wouldn't really know, but I would guess about 40 Watts?

STATEMENT

(15)J- That's a pretty good guess, actually. You put out as much as a light bulb. I put out more like a 100 Watt light bulb and you put out more like a 40 Watt light bulb. Because I am bigger.

In this instance the judge used the conversation to provide the student with information that might help her understand why a 40 Watt light bulb was a good part of the experimental design. Judge A as explained previously never made comments of this nature.

Judge B changed the topic on more occasions than either of the other judges. The request sequences on each topic therefore tended to be short unless the student asked for a clarification or did not understand a particular utterance by the judge. Of the thirteen request sequences in Judge B's conversation only 2 consisted of more than four judge's utterances. Both of these request sequences occurred when the judge elaborated and explained what he meant by his utterances. On only 5 occasions did the student lead the conversation.

Thus, each judge's style was unique even though some similarities existed between all 3 judges.

Chapter 5

Overview of the Study

This study investigated what judges looked for in an experimental science fair project and how the judges conducted a judging conversation. Audio-recordings of three judges' conversations with the same student and an in depth interview with each judge provided the data base for this study. Although it was not known at the outset what type ofinformation would be derived from the judging conversations it was assumed that this data base would provide valuable insights into the judging task and reveal some of the aspects that these judges felt were important in evaluating a science fair project.

Conclusions and Implications

For this study several hypotheses were addressed as presented in Chapter 1. In this section these propositional statements are presented along with the conclusions reached in this study:

Hypothesis 1. The written summary and project backboards will be utilized in ranking the student's project.

Only Judge A looked at the written summary. Judge A found the written summary gave an "idea of what it is that they have done, [or] what they think they have done". However, Judge A also believed that a written summary could have been produced by some one other than the student. The written report was used by Judge A solely to make it easier to ask questions. Neither Judge B nor C looked at the written summary. Both these judges felt that their time was better spent interacting verbally with the student. All three judges used the backboards to initiate questions about the project during their conversation with the student.

(1) All three judges used the exhibit and backboards to help focus the judging conversation.

Hypothesis 2. The judges' conversations (interview) with a student will be important in ranking the student's project.

Table 9 (p.) showed statements made by each judge in the interview with the researcher. All three judges stated that the judging conversation was "most important", "very important", and "important" in determining the ranking of the project.

(2) The judging conversation with a students was important in ranking the student's project.

Hypothesis 3. Judges will follow the criteria provided by the Youth Science Foundation, those used by the Vancouver (Lower Mainland) Regional Science Fair.

The Y.S.F. criteria were not used by the judges. Judge A "tried to use the criteria... but [found] it impossible to put in a numerical mark beside each one." Furthermore she added, "I don't like to use this kind of scale". Judge B stated:

> I am unable to work with those [judging criteria]. I don't believe the kids will work to them and that was verified. You'll find the kids didn't pay any attention to those criteria at all and so I didn't use them.

Judge C expressed similar sentiments in his interview with the researcher:

> I would have been frustrated [if I had tried to use them] because there is such differences in [the types of projects]. What we were looking at didn't fit the criteria.

None of the 3 judges used the judging criteria provided by the Y.S.F. However, Judge A explained later in the interview that she attempted to follow the Y.S.F.'s criteria initially because "they were the guidelines" with which she was provided. Neither of the other judges used the criteria.

All 3 judges emphasized (Table 7) the topics of care of design, originality, and the parts of the experiment. These three topics were common and recurrent in the judging conversations of all three judges.

(3) **Judges did not follow the criteria provided by the Y.S.F. Judges did emphasize three topics, care of design, originality, and the parts of the experiment, in their judging conversation with the student.**

Hypothesis 4. Judges' conversations with students will be similar to a teacher's conversation in the classroom and each judge will have a personal judging style.

Judge A and B initiated all of the request sequences in their conversations with the student. Each initiation was followed by a response from the student. The student's response was followed by feedback from the judge. Sinclair and Coulthard (1975) believed that initiation, response, and feedback (follow-up) is a "typical exchange in the classroom" and in this study judging conversations parallel teaching conversations (Figs. 4:1, 4:2, 4:3).

(4) A judge's conversation with a student is similar to a teacher's conversations with a student in a classroom in that there is an initiation by the judge, response by the student, and feedback (follow-up) by the judge.

However each judge's personal judging style was unique even though some similarities existed between all 3 judges. Similar aspects of each judging conversation were used but for a variety of different reasons by each judge. The differences in each judging conversation showed each judge participated in the conversation in his or her own way independent of the other judges and especially independent of the criteria provided by the Y.S.F.. Judge A and B had similar styles but they were not identical. For the "styles" of each judge to be identical the emphasis on criteria, the order of criteria, and the statements made to the researcher in the interview would all have to be the same.

(5) Each judge had a unique "style" of judging. Interrogator, follower, and style changer were identified as judging styles. Each judge acted as an "interrogator" for at least part of the judging conversation.

Recommendations

One must be judicious when making recommendations as only 3 judges provided the data for this study. Nevertheless, the following recommendations were derived from the conclusions:

(1) Information sent to students who intend to participate in a science fair should stress the importance of the judging conversation in the ranking of a project. The current guidelines sent to participants at the V.S.F. suggest all three aspects, backboards, written summary, and judging conversation (oral presentation) are crucial to the final placement of the project.

(2) The Youth Science Foundation and the Vancouver Regional Science Fair should develop revised guidelines for judges and students. The current guidelines are based on the Y.S.F.'s judging criteria. The new guidelines should encourage judges and students to incorporate the "parts of the experiment", "care of design", and "originality" into their judging conversation.

Suggestions for Further Research

The following suggestions for future research emerge directly from the conclusions of this study:

(1) One judge should be studied in detail as he or she judges several different exhibits in the same category e.g. life sciences. This study would provide data about the stability of a judge's style across varying exhibits.

(2) Judges of science projects in other categories such as life sciences, engineering sciences, and computer sciences should be studied. Judges of projects which are based on different sciences may use different topics of request sequences to identify the important areas of a student's project. Topics judges use in conversation with a student may be unique to a project's category.

(3) How judges determine the rank order of a project should be studied. While the present study revealed much of what and how judges judge, it did not address this important problem.

Closing Comments

In this study the researcher described the adjudication of one project at the V.S.F. by three different judges. What topics judges looked for as they adjudicated a science fair project and how they looked for these topics was determined in this study. It is the hope of the researcher that this study will be of use in showing that each judge's style is important in determining the final ranking of a project and that it will give new direction to the thinking and method of all those involved in science fairs.

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APPENDIX A

A Description of the Project "Insulation Quality of Materials"

The science project "Insulation Quality of Materials" was produced by a Grade 7, thirteen year old girl. The purpose of the project was to "investigate the relationship between a source of energy and the transfer of heat... through thick and thin fabrics". The project consisted of an experiment, a visual display where the results and conclusions of the experiment were recorded, and a notebook where the procedure used in the experiment was recorded. The student spoke well and seemed comfortable during the judging conversations. The following pages are taken from the written summary the student submitted to the judges:

The Insulating Qualities of Different Fabrics Used for Clothing

-AIM-

To investigate the relationship between a source of energy and the transfer of heat from this source through thick and thin fabrics.

-QUESTION-

What are the insulating qualities of different fabrics used for clothing?

-HYPOTHESIS-

At the start of the project I thought that the amount of heat transferred would depend on the thickness of a particular fabric. In other words, whether the insulating qualities of different fabrics would depend on the thickness of these fabrics.

-METHOD-

To investigate my aim and to test my hypothesis I made a model to represent the source of energy. In a cylinder of chickenwire I used a lightbulb to radiate heat. The lightbulb was subsequently turned on and in order to create a constant, even source of heat it was left on for 20 minutes before actually starting the experiment. Various thicknesses of fabrics were then mounted on the exterior of the cylinder. With a thermometer the rise and fall of the temperature inside the cylinder was checked at regular intervals and recorded.

-EXPERIMENT-

In my experiment I tested the insulating qualities of different fabrics with a model made of chicken wire, styrofoam, some electric wire, a lightbulb, a metal plate, and a thermometer.

[The different fabrics] were knitted fabrics, felted fabrics, woven fabrics, and wind/water proofed fabrics. [Three of each fabric were tested i.e. thin, medium, and, thick. These 12 different pieces of fabric were tested in different conditions of dry, wet, dry/wind, and wet/wind. A fan was used to create the wind.]

Each fabric was placed on the model and the temperature inside the model was checked every two and a half minutes for 20 minutes. [A total of 12 different fabrics were tested in 4 different conditions. Therefore 48 different tests should have been conducted.]

-CONCLUSION-

The results of the experiment showed the following:

(1) [The temperature leveled] off after some time due to the fact that the source of heat being transferred was constant.

(2) The leveling off of the temperature did not occur at the same time for each fabric.

(3) [All fabrics were] better heat conductors when dry as opposed to when [they were] wet. Even with wind applied the insulating characteristics seemed to follow the same pattern. [The poorest insulating environment for all the fabrics tested was when the fabric was soaked and placed in front of a fan.]

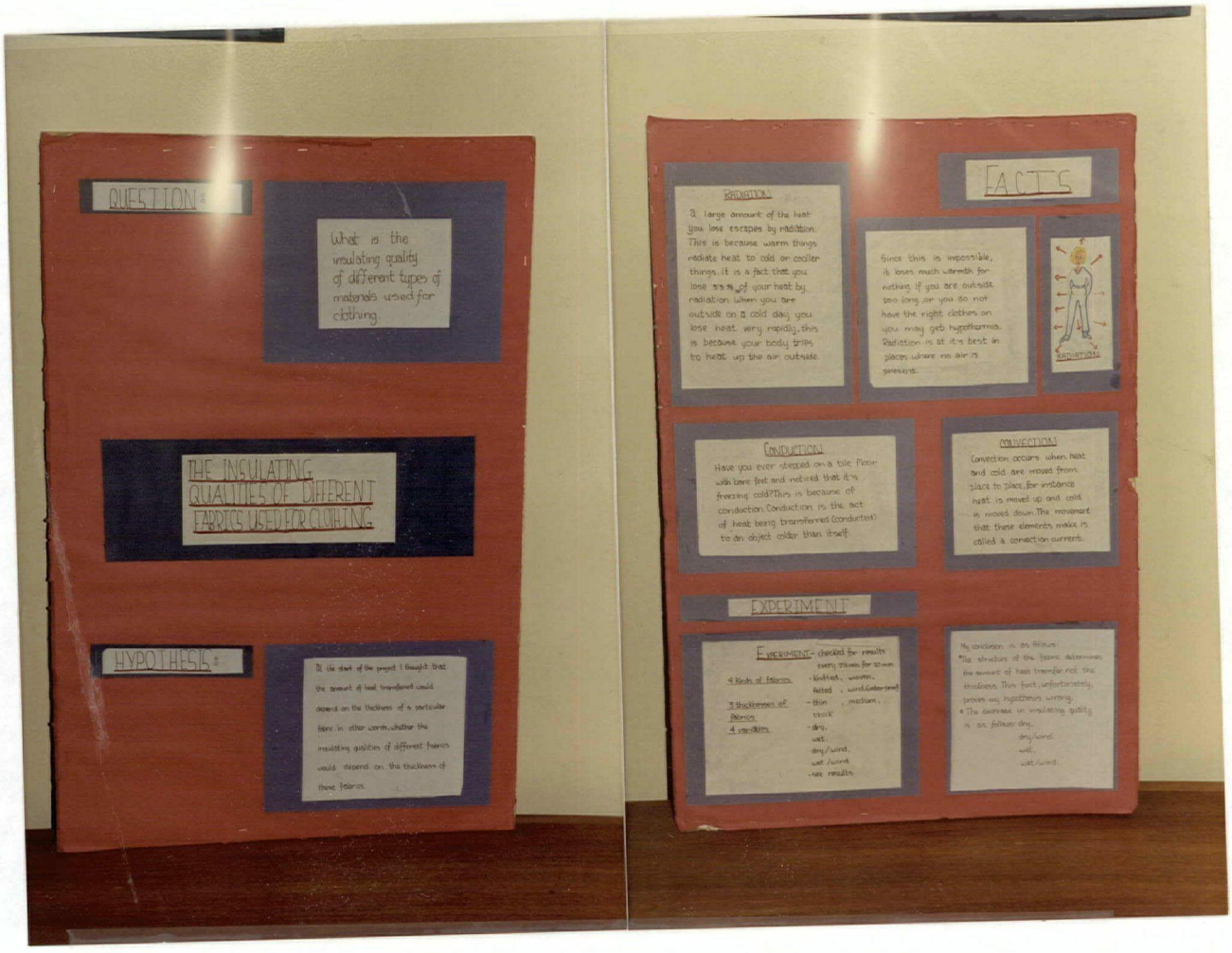
(4) The structure of the fabric determined the amount of heat transferred (or the degree of insulation). [The thickness of the fabric did not affect a fabrics insulation potential.]

This fact unfortunately proves my hypothesis wrong.

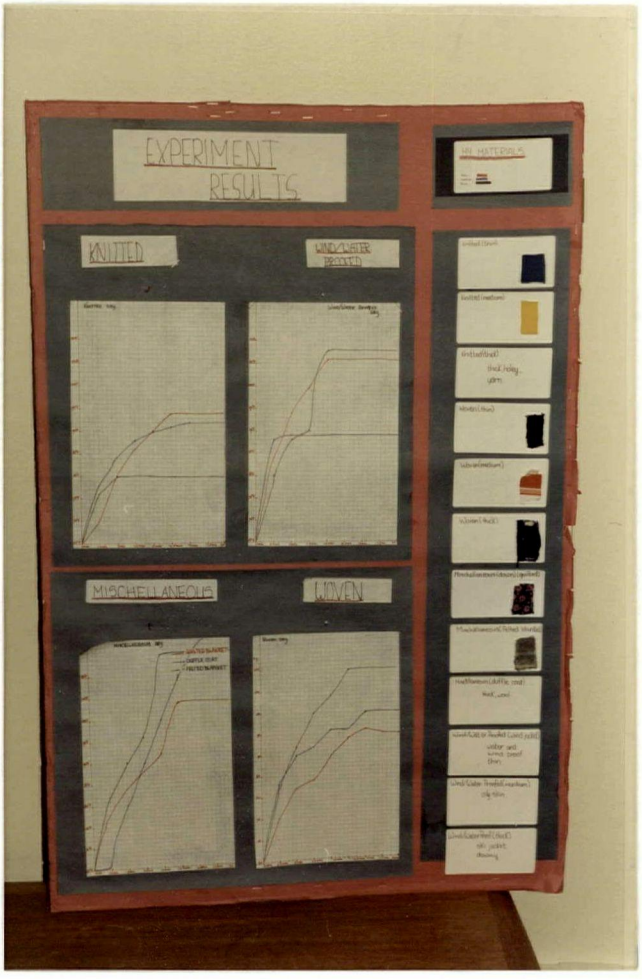
-APPARATUS-

Chicken wire, lightbulb, electrical cord, egg timer, styrofoam, knitted fabrics, woven fabrics, wind/water proofed fabrics, miscellaneous fabrics, thermometer, and an electric fan.

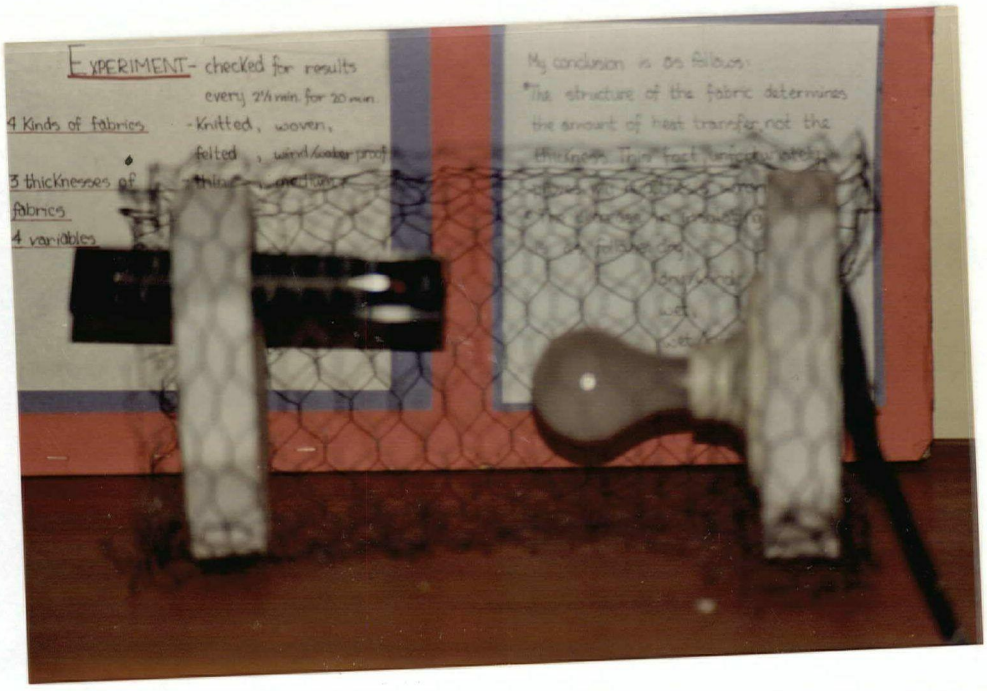
PHOTOGRAPHS
(THE BACKBOARDS)



PHOTOGRAPHS
(THE GRAPHS)



PHOTOGRAPHS
(THE APPARATUS)



APPENDIX B

YOUTH SCIENCE FOUNDATION CRITERIA

Judging Form

Grades 7-13

Project Number _____

Exhibitor(s) _____

_____

Scientific Thought (45 potential points)

1. The hypothesis was stated clearly and reflected the background readings. _____

2. There was an effective plan for obtaining a solution or answer to a question. _____

3. The project carried out its purpose to completion within the scope of the original plan. _____

4. The project shows an understanding of existing knowledge, use of adequate scientific vocabulary and demonstrates an understanding of terms gleaned from reliable sources of information. _____

5. The experimental design demonstrated understanding of the scientific methods. _____

6. The student(s) has/have an idea of what further research is indicated by the project. _____

7. There is adequate data to support the conclusions. The experimental errors inherent in the measurement made and in the materials used were recognized. (The variability inherent in living material is often not recognized by students.) _____

8. The experiment was repeated several times to establish validity of results and/or statistically validated. _____

9. The variables are clearly defined and recognized. If controls were necessary, there was a recognition of their need and they were correctly used. _____

Creative Ability (25) potential points)

1. To what degree is the problem original and the approach to the problem shows originality. _____

2. The interpretation of the data shows effectiveness and creativity; - use of tables, graphs and illustrations in interpreting data. _____

3. The construction or design of equipment shows originality. _____

4. The materials and equipment have been used in an ingenious way. _____

Note: Judges must consider whether something is original for a secondary or elementary student. It is very important to ascertain the nature of the assistance which the student has received.

Skill (10 potential points)

1. To what extent does the project and exhibit represent a product of the student's own skills? _____

2. The researcher answered the questions effectively and accurately. _____

3. Skill was shown in the development of the display:

- project requires minimum maintenance and repair under normal working conditions _____

- workmanship is neat and well done _____

Dramatic Value (10 potential points)

1. Exhibitor presented his/her project in a comprehensive and enthusiastic manner with the use of visual aids _____

2. The display board was effective in presenting the project:

- well organized and explains itself _____

- attractive and incorporates a multisensory approach _____

Summary (10 potential points)

- Has all the required information been provided within the specified guidelines?

- Has the student(s) expressed himself well in written material? How much of the written material was prepared with the assistance of other persons?

- Are the important phases of the project presented in an orderly manner in the summary? Please Comment.

APPENDIX C

INSULATION OF MATERIALS - CLOTHING

A Conversation Between Judge B and _____ at the Vancouver (Lower Mainland Regional) Science Fair on April 11, 1986.

APPENDIX C

INSULATION OF MATERIALS = CLOTHING

A Conversation Between Judge B and _____ at the Vancouver (Lower Mainland) Regional Science Fair on April 11, 1986.

(1)Judge- ...You have a funny eye there do you realize that?

Student- I guess it does look kind of funny.

(2)J- And her exhibit is titled " The Insulating Qualities of Different Fabrics Used for Clothing". My name is _____ _____, I am going to be one of your judges tonight and... Mr. Kiddell has cleared taping with you?

S- Yes, he has.

(3)J- O.K. That is fine. Thankyou very much for participating in his study.
Could you tell me what you have got here and tell me particularly some of the science behind it, I am very interested in the science... but tell me whatever you have prepared.

S- O.K. My project is to see what kinds of fabrics make the best insulators. And I chose all of these fabrics... because I had 3 knitted fabrics, 3 woven fabrics, 3 wind and waterproof fabrics and 3 miscellaneous fabrics. The miscellaneous ones included my duffle coat, this felted blanket and this quilted down because I couldn't get them into any category... And I kind of wanted to see which ones were best... The reason why I didn't get some (UNINTELLIGIBLE) for these ones was because this one was a sweater and I couldn't exactly cut out of that... And this one was my duffle coat, this one was my wind jacket, a real thin one ... and this one was a thicker one and then this one was my ski jacket.

(4)J- Did you test all of these on the garments? Or did you test those little swatches?

S- Little swatches? I don't...

(5)J- When you were testing them did you put the garment in here?

S- I didn't put them in there, I put them on top of this. So I put it... like... this isn't quite working... This was one of my fabrics. I would take

it... only I would unroll it all the way. This thing still has a pin in it... Whoops... (LAUGHTER) Oh well... So I'd unroll it all the way... that would make it too much fabric right now. So I'll just roll it half way... and I'll put this one over (DESCRIPTION OF APPARATUS - UNINTELLIGIBLE)

(6)J- I get the idea. Don't...

S- So it would have a bunch there.

(7)J- Yes.

S- It would have a thermometer in it. I would put it up to the 30 point, so that the 30 was exactly equal with this, but there wouldn't be maybe say more... thermometer in it than in a ... the other (voice trails off)... Then I would turn on the light bulb, but I would make sure that no air could get at first. Because otherwise that would totally kill my experiment.

(8)J- How did you make sure there was no air getting out?

S- Well, I would put little pins in here...

(9)J- Oh yes. So the styrofoam was nice for that?

S- Mmm- mmm. It was also kind of an insulator so this wouldn't be too exact... but...

(10)J- Mm-mm.

S- So then I would put this in to (UNINTELLIGIBLE). Turn on my egg timer and turn on the light. At first I would let the light go on for about 20 minutes so that it would be equal with the rest of the (UNINTELLIGIBLE) Cuz I would do say 4 a day. 4 experiments a day. So if I had put it straight off without heating it up yet the first one would have a cold lamp to start off with, the second one would have quite a hot lamp and the third even hotter and that would be horrible...

(11)J- What is the power of that lamp?

S- It's 40 vol...

(12)J-(INTERRUPTS) 40 Watts

S- 40 volts.

(13)J- 40 Watts. Mm-mm.

S- Cuz that is sort of like our body. Cuz our body gives off 37... 37 degrees Celsius. That's how much it

is.

(14)J- How much power do you think your body gives off?

S- I wouldn't really know but I would guess about 40 Watts?

(15)J- That's a pretty good guess, actually. You put out about as much as a light bulb. I put out more like a 100 Watt light bulb and you put out more like a 40 Watt light bulb. Because I'm bigger.

S- Mmm-mm. I would probably guess that. Yes.

(16)J- Mm-mm.

S- But 40 Watts is more what I would (UNINTELLIGIBLE).

(17)J- Yes. Yes.

S- Since it was an experiment for my kind of clothes. That, I decided I would pick a 40 Watt... and also i didn't have very much up there because some of these ones went up too much.

(18)J- Oh yes!

S- So that would almost be up to the top and if I picked a 100 Watt light bulb then that would make it say 300 or something. In some cases...

(19)J- It is interesting that you recorded Fahrenheit, was there a reason for that choice?

S- Well it was much easier to, was much easier to... get it all of there because in say, in this you would only... it would be much harder because this would have 70 and then 72, 74, 76, 78,...

(20)J- I see. So it is the finer...the finer graduations on the thermometer that decided you. That is a good reason.

S- And for the other one it would just go 30... it would do the same only... usually it wouldn't get up to 32, 34. So I thought it would be much easier... Then I put this one up here and I put my... my little timer for the 2 and a half minutes. I would check it at 2 and a half minutes record the temperature... Then I would continue on to another 2 and a half minutes for 20 minutes. Then I would let it cool off for about 10 minutes, 5 minutes. So that it wouldn't be a totally boiling hot light bulb... like when I started off the

next (UNINTELLIGIBLE). And then I put it over again. Turned on the fan and used the fan as my wind source.

(21)J- Oh I see. So you read it without a external light source. What did you have around it, was it just sitting on a table?

S- It was just sitting on the table.

(22)J- Mm-mm. Always sitting on a table...

S- Yes. Sitting on exactly the same table.

(23)J- Oh that's good. That is a good way to do it.

S- So I turned on the fan 2 and a half minutes for 20 minutes. Then I wetted this but I put it in a bathtub so that... let it soak up all of the water... or as much water as it could hold, obviously this one would hold much less than this. So I just put in as much water as they would hold and then I would do it again with just ... without anything and then I would put the wind on it. As it turned out the dry was the hottest of all... Well the hottest as far as these two are concerned. And then the dry with the wind was the second, the wet was the third and the wet with the wind was the very last. It was horrible... And these are my graphs to show it...

(24)J- I notice you have drawn this flat here but there are no points out here.

S- ...No that is because at the end , then it always leveled off. Because the same amount of air got in as got out. So it all leveled off... but all of them leveled off at a very different timing. This one it just leveled off practically right away, same with that one.

(25)J- So the fan just sat sort of like it is now?

S- Well, it was more towards here.

(26)J- I see.

S- We keep the fan in the same place so that it wouldn't be moved further away or closer.

(27)J- Mm-mm. Mmm-mm. Well that's a very nice experiment actually. I am a little worried about you doing yourself in there though. (PAUSE) With wet cloth around...

S- Yes. It does get a bit dangerous... but...(pause)

(28)J- yeh. (pause) Did you have much help with this?

S- No, because my Dad was in Holland and... so he was visiting my Grandpa. And my Mum was painting over his office and everything so I was doing this all by myself.

(29)J- Well, I am certainly glad you didn't hurt yourself.

S- Mmm-mm. I guess it did get rather dangerous...

(30)J- Where did you get the idea for the experiment?

S- Well, first of all I had heard already we were going to do a science fair. So that everything I did I was sort of thinking would this make a good experiment? And then, we got, we had to do Home Ec. ... for sewing. ... And so when I was out there getting my fabric, I was thinking which one would be the best for winter and which would be the best for summer. And then it suddenly clicked to me that that would be a wonderful experiment. ... Maybe not wonderful but at least it would make a very good experiment.

(31)J- Well, Dyana, I think it is a wonderful experiment. I think its... I think its quite original... I think it is very well done...

S- Thankyou.

(32)J- ...I think ... I think that... ah, well you've taken into account some things here which many people don't think of: Keeping conditions the same... is very important in science so you always want to ... realize what it is you are measuring. (pause) There is one thing that you might not have thought about. (pause) When the fabric was wet...

S- Yes...

(33)J- ... the water was evaporating all the time...

S- Yes. That is right. (laughter)

(34)J- So the condition was really changing all the time.

S- I guess it was... but since it was 20 minutes I didn't think that it would evaporate too much.

(35)J- No. It was still wet when you finished?

S- Yes it was. It was still more or less the same.

(36)J- Yeh. Mmm-mm.

S- ...but that was probably because it was...

(37)J- So...

S- ... totally soaked it so that it was totally wet.

(38)J- Yeh. Yeh. (PAUSE) So that is the ...

S- This one's (UNINTELLIGIBLE) in the water. But I only did this one with the dry and the dry wind. (UNINTELLIGIBLE) put my duffle coat into the water and soap it up because it would probably shrink... (PAUSE) I also did ... wet, wet-wind-dry, dry... (PAUSE) These ones were all for my background because i did quite a bit of background reading. Because I hadn't thought of my experiment... quite a while. First I was thinking of ... I liked clothes anyway. I love clothes. (laughter) I love (UNINTELLIGIBLE) and everything so I had already decided I would probably do one on clothes. Til I just sort of background and read about it.

(39)J- (PAUSE) Well, I think it is very nice. Where did you, where did you find your collateral reading?

S- In the Public Library.

(40)J- What sources... did you use? I guess you have got them listed in your...

S- Yes.

(41)J- O.K. I will look at that. I haven't had a chance to look at it yet.

S- I used a couple of pretty young children's books to start me off. Because I didn't know very much about this subject. So I decided to start off...

(42)J- You know a fair amount about it... if you designed this experiment you are doing fine. (PAUSE) You don't ... you don't... the beautiful thing about science is you don't really have to use very much outside knowledge to start with. You do have to use a lot of common sense. You have used it ...and been conspicuous. O.K. ... Well thank you very much for showing me this. I think it is really fine... I quite like it. I haven't seen the... oh, sorry, yes I'll leave that with you. (END OF TAPE)

APPENDIX D

INTERVIEW PROTOCOL FOR JUDGE B

APPENDIX D

INTERVIEW PROTOCOL FOR JUDGE B

INTRODUCTION

SHOW COLOUR PHOTO OF PROJECT AND STUDENT.
You judged this project Insulation of Materials- Clothing, student, (NAME) , and judged it as second, class. (pause) I'm sure that you remember it clearly. (pause) Now I would like to ask some questions that will help me understand how you judged this science fair project.

1. HOW DID YOU COME TO YOUR JUDGEMENT OF THIS PROJECT?
   How did you make up your mind?

2. HOW IMPORTANT WAS THE INTERVIEW IN MAKING UP YOUR MIND?

INTERVIEW QUESTIONS

I would now like to ask some questions about your interview with (NAME). Here is a transcript of the interview. You will see that J stands for judge and S stands for student and all your questions and _____ replies are transcribed.

Let me start by replaying the beginning of the interview. _____.

3. You began the interview making a statement.
   WHAT WAS IN YOUR MIND WHEN YOU MADE THIS STATEMENT?
   AT THAT TIME DID THIS STATEMENT SERVE ITS INTENDED PURPOSE?
   WERE THERE OTHER PURPOSES?

4. QUESTION #8 (PAUSE) WHAT WERE YOU SEARCHING FOR?
   WHY DID YOU LET IT GO?

5. (READ RESPONSE TO #10.) WHAT WAS IN YOUR MIND AS YOU ASKED QUESTION #11?

LET'S NOW LOOK AT A WHOLE SERIES OF QUESTIONS. PLEASE READ THE QUESTIONS STARTING AT 11 AND FINISHING AT 18.

AS YOU REMEMBER IT, WHAT DO YOU THINK WAS GOING ON BETWEEN THE TWO OF YOU THERE?

WERE YOU SUSPICIOUS AS TO WHETHER DYANA UNDERSTOOD THE RELATION BETWEEN THE HUMAN BODY AND THE BULB?

WHAT WAS MEANT BY 300 IN #18? CAN YOU EXPLAIN THAT TO ME?

WHAT LED YOU TO ASKING ABOUT FAHRENHEIT IN #19... OR WAS THAT A FRESH IDEA?

6. NOW #21 SEEMS TO INTRODUCE A NEW CONCEPT OR IDEA... WHAT WAS THAT YOU WERE SEARCHING FOR THERE? DO YOU REMEMBER WHERE THAT IDEA CAME FROM?

7.(Take Judge B through this sequence) IN THE RESPONSE TO #23... THE STUDENT RAISED AN ISSUE THAT YOU RESPONDED TO IN #24... YOU THEN LEFT THIS AREA AND RETURNED TO THE FAN IN #25.

DO I UNDERSTAND THIS CORRECTLY? THIS IS WHAT HAPPENED?

8. PLEASE READ SECTION #27-#30.

THERE ARE TWO POSSIBILITIES (1) THE STUDENT BEING EXPOSED TO AN ELECTRICAL HAZARD WITHOUT SUFFICIENT SUPERVISION

AND/OR

(2) TOO MUCH HELP FOR IT TO BE CALLED HER PROJECT. THAT IS TOO MUCH ASSISTANCE.

WERE BOTH THESE THINGS GOING ON?

9. THERE IS ANOTHER VERY INTERESTING SEQUENCE #31 - #35.

WHAT WAS GOING ON HERE?

THESE ARE INTERESTING QUESTIONS. I WONDER COULD YOU TAKE ME THROUGH THESE QUESTIONS AND TELL ME WHAT WAS IN YOUR MIND AS THE SEQUENCE PROGRESSED?

10. YOU ENDED THE INTERVIEW WITH A SERIES OF STATEMENTS. WHAT WAS IN YOUR MIND AS YOU MADE THESE STATEMENTS?

WHY DID YOU END THIS WAY?

--------- END OF TRANSCRIPT QUESTIONS ----------

INTERVIEW PROTOCOL FOR JUDGE B

11. HOW DID YOU COME TO YOUR JUDGEMENT?
I would now like to ask some questions not asked at the beginning.

Did you pre-view the project? Yes/No. Why? Value.
Did the student make a presentation? Yes/no. Value.
Were you comparing this project to other projects you have seen? Were these projects in the same category? (looking for relative or absolute standards)

12. WHAT WAS THE PURPOSE OF YOUR INTERVIEW?
Were you confirming your judgement or making a judgement?
Were you using a pre set format for your questioning?

NO	YES
This is a sequence you seem to use see yellow sheet	DESCRIBE
What prompts the sequence of ideas you use?	IDENTIFY FORMAT

DID YOU USE THE JUDGING CRITERIA PROVIDED BY THE ORGANIZERS? WHY/WHY NOT?

11. REFLECTION ON JUDGEMENT - AN INVITATION.
How do you view the project now?
How do you view your judgement of the project now?

APPENDIX E

INTERVIEW WITH JUDGE B

APPENDIX E

INTERVIEW WITH JUDGE B

R- Okay, what this is all about is I'm going to try and key you into one particular project. The way I've gone about that is I've made a transcript of one interview and I've some photographs that might help you remember. It's the project by (student's name and project number). This project was awarded a second class at the fair. It was the Insulation of Materials--Clothing. I'm sure you remember it.

J- Oh yes. The girl was wearing, as a matter of fact insulating...one of those...what do you call them???...fabric that has convolutions in it...insulating fabric...underwear I think! She was wearing an underwear shirt!

R- What they call thermal material?

J- Thermal underwear!

R- I'm going to ask you a couple of questions and then I'm specifically going to go through some bits of the interview to clarify if I'm understanding exactly what it was that...

J- Okay, do you want me to read this first?

R- Would that be helpful to remember it?

J- No.

R- Okay, good. Just a general question about this project is how did you come to your judgement of this project?

J- Actually, I judged this more highly when I thought it was original than I did subsequently. I believe I told you the interaction I had with the girl from Summerland right afterwards?

R- Oh...and this is the one.

J- Yes, this was the one. I thought this was a terribly competent job and if she had conceived it all herself, done the experimental design, worried about all the details, she had certainly done a .....job.

R- What did the girl from Summerland say about it that influenced you?

J- The girl from Summerland, who's name escapes me, was the one who did the project on the heating values of wood. I

noticed she was from Summerland and I said, "Oh, were you here last year?" She said, "Yes, I was." I said, "What was your project then?" She said, "Well, I did a project on the insulation values of fabrics...with a light bulb and a thermometer." I think then more things became clear. I think that is the reason I rated the fuel value of wood higher. So she was saying the right things, but I have no reason to believe there was any guile involved. She was a totally guiless individual as a matter of fact. She was an incredibly timid individual. I took Evelyn over to introduce her even after the judging and everything was all over and she was still very withdrawn and mousey.

R- Yes, that's true. That's not this girl though, that was the girl with the wood burning project.

J- No, I was quite impressed with this girl. This girl seemed bright. She definitely did know why she had done what she had done and that is very important with me. There seems to be a large number of kids out there who are capable of following instructions and it is believed that following instructions is a valuable end in itself and I've never believed that at all and I've always at least raised my own children to take a questioning attitude to following instructions. And that gets a little infuriating to other people as a matter of fact, who are interacting with my kids. They eventually learn that my kids are not being smart assed but they're being reasonable, it's just they're taught to live that way, that's all.

R- Not to be prescribed.

J- If they can think of a better way to do something, I've told them to do it one way and they can think of a better way, and as long as they tell me why it's a better way, I say go ahead and do it. They've always had that freedom.

R- In your judgement, what was the...there seemed to be what I'd call several parts to the project. Some of them being the display, the backboards, there might be an oral presentation where the student talks, there's a written report usually and there's the interview where you talk to the student. Are those important to you and in what ways?

J- I think the thing that was most important was her scientific problem and her experimental design to find the solution for that problem were immediately transparent. She explained them in not too many words very clearly. She explained what she did, she explained why she did it, as I said. Immediately I could put things for my own knowledge on it, but to a greater extent I didn't have to with this girl than I had to with for instance, with the pinhole camera girl before her who really hadn't the slightest idea of how a pinhold camera worked. And the pinhole camera is actually an easier thing to understand than the project

this girl had. So I guess I was really grading, you're always grading context. I've seen many science fairs and this girl's was a cut above most science fairs. I have to say those pinhole cameras were not bad...they were a cut above most science fairs, but they weren't original. This one looked original to me. I'm sure there is a fair element of originality in it even with my subsequent information.

R- So, that interview then, from what you said there seems to be you know, the interview is the most important aspect.

J- The interview, yes, is the most important. I tend to judge the participant more than the exhibit if the participant seems to be involved with and interested in the exhibit, that's important. If the participant is knowledgeable about the exhibit, that's important. The graphics quality doesn't impress me at all. Her's was average as it turns out, but that is not important. If that was important then the second pinhole girl would have washed away....those razor boards really got me...those lettraset razor boards. I couldn't quite understand why any sentient parent would let that get out of the house actually.

R- What I'm going to do now is ask you some questions about your interview with (STUDENT NAME).

L- _____ is her real name.

R- I've given you a transcript of the interview and you'll notice I've put 'J' and 'S'. 'J' refers to your responses and 'S' to the students. And I've also numbered your statements and questions, so I'll refer to those numbers as we go through. What I'd like to do is play the beginning of the interview, just to give you the girl's voice again. (Plays tape) You began the interview by making a statement...what I consider the beginning is right here where you referred to the science and whatever you have prepared. What was in your mind when you made that statement.

J- Some students had memorized a spiel and the spiel went through history and various other things. The origin of degara types didn't really interest me very much in this exhibit because the exhibit wasn't about degara types. So what I wanted to do was cut through to it, probably again, a carry over from the previous exhibits, the previous talks. I also wanted to see if the student is capable of expressing thoughts other than those that were written down in detail in advance. And as a matter of fact, Dyana as I recall extemporized. She did not give me a prepared spiel. And she extemporized as a matter of fact, articulately, which I rate highly. As I said, I judge strongly on the individual performance. I didn't ask her what career are

you planning for. She's not from Crofton House is she?

R- Yes, she is.

J- Okay, I had two exhibits from Crofton House when I judged there and I said, "Oh, yes, what are you planning to go into." I thought they were quite good so she said, "I'm going to become a lawyer." The next girl to her you know, I decided to ask the same question after I had finished...I thought her's was quite good too. I asked her what she was going to do, she said, "I'm going to become a lawyer." Two in a row! I quit asking the question.

R- Were there other purposes for that introductory statement?

J- The purpose was that I wanted really to cut right to the science. My introduction to the girl was, I guess fairly abrupt at that point. I had gone through two at that point.

R- No, I didn't think you were too abrupt. I thought you led in marvellously. She felt...you seemed to have loosened her up.

J- Oh, I think she's a very poised, at ease individual. That impressed me about many of the competitors this year. They've talked to adults.

R- I think it's on the next page of your transcript. I'd like to jump to question 8.

J- "How did you make sure there was no air getting out?"

R- What were you searching for.

J- The principle mode by which heat is transferred in most processes that occur in the atmosphere is convection. It is very important to distinguish convection from conduction. Insulation is a measurement largely...there is a process whereby the conduction is minimized. If you leave leaks in the house, you know it cools faster than anything else. You can talk all you like about the R-values of the walls--they can be very high, but if you open a door, you can forget about them, they don't matter, they can be twice as high, that's not going to make any difference. So I wanted to see if she had worried about that. She had. I actually asked a different question than the one she answers. I asked, "How did you make sure there was no air getting out?", and that is a question of did you have some way of determining if there was hot air leaking anywhere. Did you feel something else like that? Actually what she answered was, "How did you assure there was no air getting out." She did that by putting pins in.

R- So, that's why you left that question? In 9 you go....

J- Well, she had worried about it. The point is that is certainly a thing that she had worried about. She had styrofoam ends in her...she had a chicken wire cage...styrofoam ends, and the styrofoam ends were ideal for poking pins in and sealing leaks. So there was some concern.

R- Great. Great. In the response to 10, it says, "So then I would put this into...turn on my egg timer, turn on the light. At first I would let the light go on for 20 minutes so it would be equal with the rest of them because I would do, say, four experiments a day. So if I would put it straight off without heating it up, yet the first room would have a cold lamp to start off with and the second one would have quite a hot lamp, and the third even hotter, and that would be horrible." Question 11 arises out of that I suspect. What was in your mind as you asked question 11?

J- Oh, I didn't know what the power of lamp was. I was wondering how hot things would get. I would not put a 100 watt lamp in there. She said it was 40 volts and I said it was 40 watts.

R- She persevered with 40 volts and you persevered with 40 watts.

J- Actually, there was something distracting. It turns out, I think she got less help from that than she should have, because one of the things I would insist on if I had my kid draping wet clothes on things is I would insist that any volt stuff be well insulated. This was a little bit raggedy. That is one thing that did impress me about her exhibit....it looked like she had done it.

R- Yes.

J- She might have gotten help from an older brother, but not a much older brother.

R- Okay. There's a whole series in here. 11 right through to 18...basically that whole page, where it starts off with 40 watts.

J- Oh yes, where we talk about the output of a body. She knew that was about what a human body put out or she guessed that's what it was.

R- And 17 has, "Since it was an experiment with my kind of clothes...."

J- She actually tested her own garments. She tested a duffle coat. I thought it was very nice.

R- Yes. Were you suspicious as to whether Dyana understood the relation between the human body and the bulb?

J- No, not at all.

R- You seem to be going after that they should be equal, there should be some relation for choosing.

J- No, that was entirely tangential. That was not central at all.

R- I see. Okay.

L- Well, I wouldn't put a 100-watt bulb in there. If you look at the little lamps you buy, it tells you 60 watt maximum. And the reason is if you put a 100 watt in there it will cook the fixture screwed into and it will eventually die because that's too hot. I wouldn't have gone above a 40-watt bulb in there. It's interesting that she had picked it. I believe fully now, because a 40-watt bulb is not a standard size that you keep around the house, usually 60's and 100's...I believe fully that she had found in her set of instructions that she should use a 40-watt bulb. It gives a large enough temperature difference to be measured on a crude thermometer, but it's not going to set fire to anything.

R- Right. So it didn't concern you...you weren't after seeing that she used something that would approximate the human body temperature?

J- No, well she would have to approximate human body size....

R- In 19, there's...

J- I asked her why she recorded in Fahrenheit. I had a reason in mind, but the thermometer she was using was graduated in two degree steps for each of Fahrenheit and Celcius--they were both on this thermometer. The higher precision measurement could be done in the Fahrenheit size for that reason. The spaces were 5/9's as far apart and so, if I as a scientist, I would have done exactly the same thing. I asked her why she did it and I think I put that into her mouth later on.

R- So 19 didn't come out of the other, that was just a new line of thought.....

J- Yes. Well she handled the questions exceedingly well.

R- It was a masterful interview you conducted. It was a pleasure to listen to it. I enjoyed it.

J- I don't know if it was a masterful interview. I enjoy these kids; I really do.

R- I think that's what I mean by masterful. I look at mastery of where the kid is at ease, there is a good interplay between the people...that to me is fantastic.

J- Oh, yes. I had no trouble getting things out of her, but when do you take the winner? Did you listen to the winner's interview?

R- Yes, I did. You worked a little bit harder.

J- That was a lot more work.

R- In 21, "Oh I see, so you ran up with an external light source....", it seems to introduce a new concept or idea as opposed to you're going on through all ....

J- This is convection again. If you just have that apparatus sitting in the middle of a table, then it isn't cool so strongly by breezes coming up past it. If you were to spend it out in the air, then warm air could rise from it and cold air could come in from below and cool it more.

R- So, this is the idea of control?

J- No, if they were all done that way, then that would have been fine, but they should be in some standard condition. She said she did them always sitting on a table...always is the key word. No, I said always sitting on a table and she said, "Yes, sitting on exactly the same table...that was the point. I told her that was what I was looking for, so she answered that one right. I wasn't going down point by point, but when she said something right you want to reinforce it.

R- Sure. I'm just going to take you through a sequence here if you don't mind. In the response to 23, the student comes up with, "And then the dry with the wind was the second, the wet was the third, and the wet with the wind was the very last. It was horrible and these are my graphs to show it." The student raised an issue that you respond to in 24, you refer to flatness of the graphs. The student has pointed out the graphs to you and you....You then left this area and you returned to the fan in 25, so the fan just sort of sat like it is now.

J- Well, she had no reason for what she had done which was not right. She had done something wrong. What her curves looked like was this...she had points going up like this...they went like that and she would draw her line and after .....(laugh) I don't exaggerate the abrupt shift. I'm just not used to things going like that.

R- So there was no way....

J- There was no way she was going to justify that, so there's no real point in...

R- So were you going back in 25?

J- If I had not been judging her at the time, I would have spent more time on that point. If I had been wanting to discuss her experiment and take her farther, I would have spent a great deal of time on that, but I think I did with the kid with the hot air balloon, as a matter of fact. He got considerably more of that sort of treatment, but she did not because I wanted to see what she had done and then we went to other things.

R- The reason I was interested about 25 being the fan after that, it had seemed that is what you had left earlier. I was wondering....sitting on the table...the fan came up in response....

J- I think she was getting back to her usual line of presentation that was all. She did have a line of presentation. It just wasn't a memorized line.

R- So that line, would you suspect, she would try to give that same line to the judges.

J- I think more or less. Well, you will know that better than I!

R- (chuckle!) Okay, in the section 27 to 30, this is one we mentioned earlier. That was the bit about the danger. You were worried about that it wasn't insulated well enough as referred to. There are two possibilities it seems to me: the student being exposed to an electrical hazard without sufficient supervision which you've mentioned as being a concern. There's also the possibility when you asked, "Did you have much help with this?", that it was too much assistance. I mean....

J- Oh, no, no, no!!! It was exactly that thought you know that this thing was sort of hanging open.

R- So you weren't putting the student in a situation where if she answers, "Yes, I did have parents help me", the student might go...is used to saying no because people take that as a negative--too much parental help, but realize that she should have had parental help because of the danger of electrocution. Okay, so this is the danger.

J- Yes. The kid won't electrocute herself. You can't kill yourself with 110 unless you make special efforts, but you can sure hurt yourself--jolt!

R- We're getting up to the last sequence--a very interesting sequence. 31 to 35, what was going on there? We've got, "the water was evaporating all the time, so the condition was really changing all the time"...and 34.

J- "The water was evaporating all the time, so the condition was really changing all the time..." It's not. That's all right!

R- ...it's not?

J- No. It's evaporating all the time--it's called steady state. That's a distinction.

R- Were you looking for her to come up with steady state?

J- Certainly not. My students don't understand the distinction between equilibrium and steady state until after they've had it bludgeoned into them over a period of a year. I wonder if they understand it now?

R- You were looking for some idea of controls?

J- No. I realize there was a criticism of this experiment that it didn't have any controls. That's what Donna told me. I said, "I don't know what you mean. There's been somebody trying to write a recipe for doing science and it always seems to involve controlled experiment." And one of the things I pointed out to her was that I am a professional scientist and for the kind of science I do, it's impossible to have a control. All I do is go out and look at stars, and star A, if it is truly wonderful, is different from any different star in the worlds. Star Tecorbor which is one of my favorite stars...there ain't no other star like that and I can't do experiments on it. Astronomers don't do experiments. We simply observe. This narrow straight jacket idea that there is a scientific method that involves things like controlled experiments is just wrong. I'm sorry I don't pay any attention to it. Donna feels the same way, incidentally. But I just won't pay any attention to it. I've got to evaluate what was done on its own merits and not by somebody's, external person's norm. Meaning the norms were set up by a non-scientist. The scientific method, as you know, is a creation of one small branch of philosophy.

R- Right. And as many who challenge that is Kuhn. I'm just going to go at you one more time about this because you seem to keep going at it in 33, 34 and 35. So the condition was really changing all the time. It was in 34 there and that was....

J- Well, she's not going to come up with steady state.

R- But you were looking for her to come up with whether she

was aware of any problems in that.

J- Yes, yes. Did she have any speculations. I would have told her about steady state if she was inclined at all to go into it. You know, is she said, "I never thought about that" or "What could do that?" If she would have asked a question, I would have answered.

R- You ended the interview with a series of statements, really I guess starting at 39 sort of starts it off. Well, actually even later than that...I guess 41, 42, and then in 42 you have a bunch of statements in there. What was in your mind as you made those statements?

J- I'm always interested in the sources of information. In your...oh, I'm pointing to her report...in your...in other words her bibliography in there...

R- Right.

J- In near 40.

R- Right.

J- I didn't.....(couldn't make it out)...I didn't read any of these things.

R- So this originality of the idea you had some... is what I'm calling originality, that is what you were after?

J- That's right.

R- And that's why you obviously,...I'm putting words in your mouth so just tell me if I'm wrong...is that my hunch was when I looked at the sample, okay, you had some concern there. Today when you mentioned that you talked to this other girl from Summerland....

J- ...and found out that she had done very similar work, if not identical...

R- ...which reinforced your.....okay, great. And in 42 you go, "You don't ....on sciences, you don't really have to use very much outside knowledge to start with", and then you go on explaining from there. Why did you end it that way? What's your purpose for ending that way?

J- I think that interview went a full 15 minutes, that's one of the reasons.

R- Right. Okay. Is there anything in your closing statement, any purposes to those?

J- No conscious ones, no. Let's see. "You know a fair

amount about it. If you designed this experiment, you're doing fine." Oh, you're wondering about the "if you designed this experiment". I have funny locutions and there is nothing sinister about that statement.

R- Actually, I wasn't picking on that.

J- For instance, I have a locution that really bugs the hell out of people. I will sometimes ask questions in the claritive and it's something my wife has no trouble with!

R- What I was looking for there, is that it seems to me in any interview there's a beginning, middle and the end. I'm just wondering if you're closing off the interview, trying to leave the student with a good feeling, that sort of thing. Does that go through your mind in this interview?

J- Except in the case of the nuclear power kid, I would say that's always in my mind. I want to leave the kid feeling that that went fine.

R- I think that came to me through your whole conversation. I felt that you were very concerned about not hurting the child's feelings.

J- Well that was only a problem with the nuclear power kid and the plastics kid. Nobody could hurt his feelings.

(DISCUSSION OF PLASTICS)

J- The kid with the hot air balloons as a matter of fact, did get a prize in that category partially because I think in the judging dynamics because of his contrast to the kid in the plastics who had similar experiences with the other judges.

R- Interesting!

J- They didn't like his attitude and I think that I tend to judge the kid. The other judges I think are less open about it, but I think they do it too!

R- Yes, okay. Back to this project--Dyana's. If she got a second class, is that what you ranked her individually? Did you have her second prize.

J- I think she was close to first. I think hers, as I recall and the fuel value were considered definitely the two class exhibits and we had to sort of cast about for the third. The two pinhole cameras were considered along with the hot air balloon which did take the third. We had a little bit of judging ... there. I don't know if you wanted Kit in on that, but it worked fine.

R- No, no. That was fine. Sorry! I asked at the

beginning, how did you make your judgement, and you said you made it basically on the exhibit. I'm just going to ask some questions now that I didn't ask the beginning because I didn't want to...

J- Okay, let me be a little freer on that. I was really impressed with the originality of the girl who did the wood burning. It was clear she had not done the whole exhibit herself, but she readily said that and she told me just what she had done as a matter of fact. Now it was clear that a kid could not have executed that. A kid could certainly have conceived it and carried out the experiment, but could not have executed the apparatus. But since many kids were using things like electric fans which they didn't build, I didn't see anything wrong with that. And she did do a lot of the...well she said, "I did the cutting of that", and she explained to me....she did know how it was put together. For instance, where there was a little door that you had to open up to put the wood in, well, it went between some guides. When I first looked at that, not being a tinsmith, I looked at that and thought she had quite a sophisticated break to make those bends so she could slide the door in. She pointed out to me, "Well, that's the way that flute pipe comes. We just used the edge of the flute pipe which already had that bend in it." I thought that was pretty good. She was clearly, intimately involved with the construction of it and it was not something that she...she said, "Grandpa, could you make me this" and Grandpa went off and made something. Obviously, the workmanship was finer and he had done quite a bit of it, but no more than I would expect. It was entirely reasonable.

R- Did you preview them.

J- No. I was in the welcoming ceremony.

R- Right. So you didn't get a chance to see them before hand?

J- No. Not at all.

R- I see. So would that have been of value to to have had a look at them before hand?

J- Yes. It would have worked...I'm not sure if it would have worked to the detriment or the advantage of the one who ultimately won. My strongest impression of the girl who won is not that she really knew what she was doing, I think she did. My strongest impression was how incredibly painfully shy she was. How difficult it was for her to interact with judges.

R- And that gave her the edge, over let's say, this project?

J- Well, I don't think that's an advantage.

R- What I'm saying is...empathy...if that might be....

J- No. No. No. Well, I probably have a little bit of that because I have one kid who is obviously socially less adepth than the other three, you know. I might lean to giving him an advantage ocassionally. But know, I don't think that came in.

R- I didn't think so either.

J- I think originality was very important because I don't think that's anybody's science fair exhibit. In fact that she came up with apricot as the most calorific wood--that was impressive! I failed to ask her one question which I meant to ask, but she sort of diverted before she got to it. I don't know how she weighted her wood. I really wanted to know how she weighted her wood and I never found out. Do you know?

R- Yes. Somebody....I listed to that. I'll look it up for you. I can't remember off hand. I heard her on the tape. I listened to these two projects....unfortunately, I had a technological problem. I was going to do wood burning for the transcript, but it was lucky I had....

J- Well, she had a very low voice, too.

R- And it was very hard in that sense, too, to pick up. So, from what we've been talking about here, you are obviously comparing when you make up your mind, this project to other projects.

J- Well, no. I was only comparing the two actually. They were clearly better in my mind before I went through the judging dynamic through the interaction of the other three judges. When I went in, I think I was the fourth to judge in to that, they had already concluded the same thing that those were the only two that were in serious consideration for the first place.

R- So, now you're judging on the basis of the 8 projects you have. You're not going to other fairs I saw.

J- Oh no. I was very impressed with these. I thought just in our group of junior experiments the quality was much above what I had seen even at the higher level. Forget about the fact that it was junior intermediate level. These were much better.

R- But if they had been lower, you would have still judged just within the group. Is that right?

J- Well, yes. I did see one other exhibit during the time I was judging. That was the ocean waves exhibit. But I don't think that I considered it in the same way at all. In the first place, the kid was older. It was unrelated in subject matter. I think those 8 were the only ones on my mind.

R- In your interview were you confirming a judgement? Did you go up and fairly quickly get an impression or were you making a judgement.

J- Since I haven't....in advance, I didn't really know what the exhibit was. The time I got there to judge her was the first time I had been there. What did I notice about her? There was the fact that she had on thermal underwear, which I didn't comment on at all! I didn't know she was from Crofton House or there wouldn't have been any real problem. Some of these kids are poor, you know! I don't make any comment at all about their clothes, you can put them off. So I didn't say anything. I gather she isn't poor. Anyway, I didn't know what her exhibit was until she told me and then I looked at her boards and her graphs and so forth.

R- Do you think if you had previewed the exhibit you would have been confirming a judgement?

J- I think so, because I think that visually her exhibit was probably the most appealing if not the best. Maybe that professionaly prepared exhibit was better, but hers was very appealing.

R- So, we were talking earlier how you can pick a good project by going through it and things like that.

J- That's all I taped is it. Because I talked to her some more. That's how I knew her name was Dachmar.

R- Yah, that's all that was on the tape. I guess you just..... Do you use a preset format for your questioning?

J- No, certainly not.

R- So what initiates your questions?

J- I simply go in and say I'm going to interact with this kid and find out how good a kid this is. Remember I'm judging a kid. The subject we're talking about is the exhibit at hand and that is a focus. I know the kid should be ready to talk about it and I can judge the kid pretty easily that way.

R- I wrote down here...you're going to object to some of the words I used. I saw a sequence in this one interview where you had a beginning and then you had an ending and

then you went after certain things. You went after the test design how it was set up and went through what I use the word 'control' here where we referred to convection.

J- I would call that care of design. That is a matter of design, but I think control is one that relates to having some standard to which things are compared.

R- Okay, super. I used that again down here three times. Good! Well, I was checking if I mean there was a possibility that might have some set way while you were going through. Okay, well, I think I just have one more here. A big one for your here. Did you use the judging criteria provided by the organizers?

J- No. But I knew those in advance.

R- Yes. And why didn't you?

J- Because I'm unable to work with those. I don't believe the kids will work to them and that was verified. You'll find the kids didn't pay any attention to those criteria at all and so I didn't use them.

R- So you say the kids. What sort of criteria do you have some....?

J- You know objective criteria are very hard to come by. Originality is very important. Depth of understanding which you can ask of those kids. They are not too young to have deep understanding. I have never felt that I was pushing the kid too far. When I came to the limits of the kid's knowledge, I knew I was there. We would go talk about another area. It was fine and I don't think I got a kid who said, "I don't know" and subsequently said, "I don't see what you mean". I don't think I've ever pushed a kid to that point. If they get into that, they're feeling down and it's a very bad thing to hit. You've lost rapore. I think I had good rapore with Dyana, but she is a very personable girl so she'll get along with most anyone.

R- I'm just going to close up now with what I call a reflection of judgement and invitation. How do you view the project now? Are you happy after going through this?

J- I think we picked the top two right.

R- Good, so my next question is how do you view your judgement of the project...obviously you're satisfied. Good! That's great! Is there anything you'd like to add?

J- I might note that there were judges in our group and I forget which ones. Maybe Judge A who actually kept point totals and came to a insubstantially different conclusions, so...you know, if you play by results, paying attention to

the points would not have done me any good. If I were picking kids for a team to take to a science fair, I would evaluate them on my own gut feeling. I should also tell you that I'm very sophisticated in picking very good kids. I've been recruiting here at Simon Fraser for decades and I can tell in interviewing a kid, usually how good that kid is. I don't know why, but I can. I get very strong impressions and it's not anything extra-sensory or anything subtle...I shouldn't say extra-sensory, of course it's not extra-sensory!....it's not subtle at all...it's very strong. I get the feeling with these kids that that kid has got it! I want that kid. The kids can also sense that they're wanted when I detect this! I would take this girl for instance. I will predict right now that that girl will be a big success in university. The Summerland girl certainly has all the stuff to be a big success at university, except the social skills. I'd like to see some exposure of that girl to adults. And if she were exposed to adults and wanted to go into the sciences, and they don't all, then I'd like to see her as a science student. I think that science is one of the things she ought to explore. I doubt that Dyana will be a science student. She has personal skills already developed in poise which will probably equip her to do other things. I suspect she comes from a social stratum which will not esteem going into science highly anyway and she might do something else. Do you know anything about her parents?

R-Nothing at all.

J- She's obviously Dutch by her name, although she is very dark. Maybe only her father is Dutch.

R- Thanks very much for your time.