Let's Talk Science
Brownie and Guide Scientist Badge Programme

The impact of participation in the Scientist Badge Programme on Science Attitudes

by

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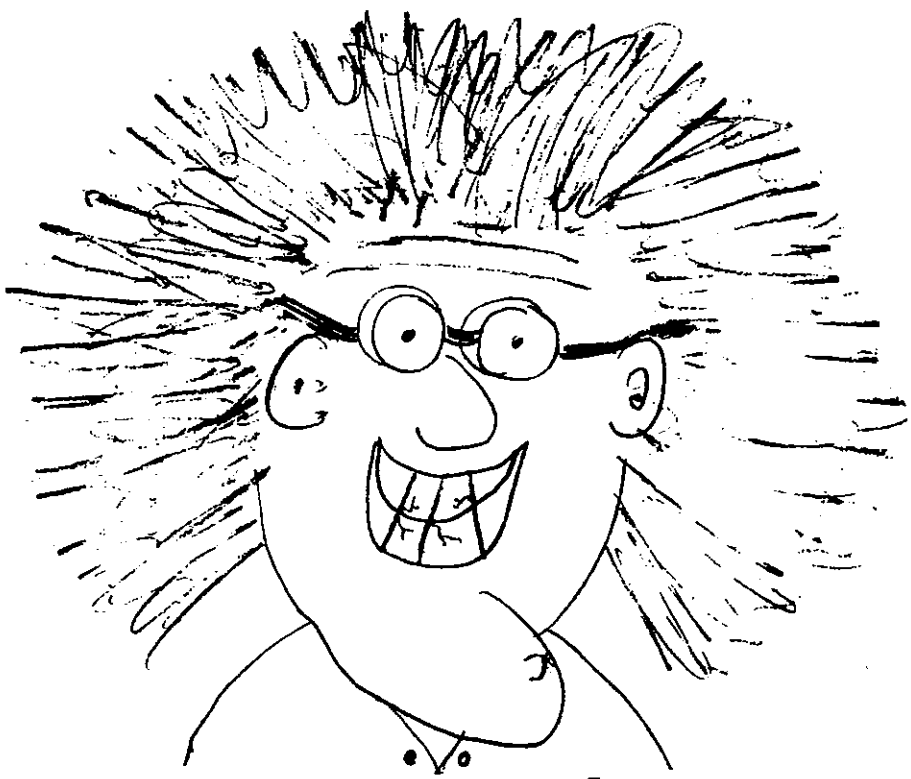
Turn on your television some Saturday afternoon. Find the station with the monster movie. Now settle back in your chair and watch the stereotypes parade across the screen. There goes the beautiful girl. Not far behind her, and quickly gaining, is the monster. And who is that lurking in the shadows: the ugly lab coat, with rimless spectacles and the crazed look on his face? It's the scientist, of course. Brilliant, cold-blooded, unleashing horrors on the human race. What he does not inspire is the desire to emulate him. And that is the root of science anxiety. (Hassard, 1990)



Completed by an 11 year old girl
before participating in the Let's Talk Science
Guide Scientist Badge Programme

ABSTRACT

Let's Talk Science is an outreach science education programme at the University of Western Ontario. One of the undergraduate science student initiatives is the Brownie and Guide Scientist Badge Programme in which university student facilitate an evening science activity session with the groups. This study evaluated the impacts of involvement in the activities on the science attitudes of the participants. A twelve indicator "scientist scale" was used to grade the pictures according to their portrayal of stereotypical science attitudes. It was found that the Brownies (aged 6-9) had more positive science attitudes and were more affected by their participation than the Guides (aged 9-12). Brownies were also found to illustrate female scientists more frequently. Research into the influential nature of extracurricular and educational experiences on the science attitudes of young girls is used to support the findings.

INTRODUCTION

"Fun!" is not a common response to the question: What is science? The unfortunate reality is that the stereotypes promoted throughout our lives tell us that science is about "mad scientists", "impossible problems", "chemicals" and "bad marks". Other popular misconceptions include "science is hard for girls" and "girls don't do science".

Investigations into the barriers facing girls and women in the sciences have established that negative science attitudes are perpetuated in schools, family and peer groups and through the media (Simpson & Oliver, 1990). Koballa (1989) established the links between attitude and behaviour. In this context, chronic under-representation of women in science can be a behavioural expression of the negative science attitudes expressed in young girls.

In 1957, Mead and Metraux conducted a survey of science attitude by asking children to complete a series of science questions, including "When I think of a scientist I think of....". The majority respondents described a lone scientist in a laboratory. The most common physical appearance consisted of "a mad professor wearing a white coat...half bald, talking with an accent, peering over his glasses, standing in front of a bench covered with apparatus." Additionally, one third of all participants depicted male scientists. Over the last three

decades, a series of similar studies have reported the prevalence of the same "mad scientist" image (Chambers, 1983; Hill et al, 1990).

The acknowledgement of the impacts of negative science attitudes on future academic and professional choices (Rand & Gibb, 1989), illustrates the necessity of early exposure to and enjoyment of science activities amonsgt young girls.

The Programme

In 1990, Let's Talk Science, (LTS), a science education outreach programme was developed by Bonnie Schmidt, a graduate student in Physiology at the University of Western Ontario. The goal of the programme was to increase the general awareness of science and science related issues within the community. Another LTS priority was to increase the involvement of young girls and women in scientific interests and careers.

One of the most popular LTS outreach initiatives is the Brownie and Guide Badge Programme. It was developed to fulfil the requirements for each groups' respective Scientist Badges and to promote positive attitudes towards science within the groups. The programme consists of one evening session of three hands-on science activity stations. Activities at each station are facilitated by an undergraduate science student.

The Study

The following study evaluated the impact of participation in the LTS programme on the science attitudes of the Brownies and Guides. Drawings of "scientists" completed by experimental and control groups, both before and after having completed the activities, were used as a measure of science attitude. It was concluded that Brownies had a more positive attitude towards science and scientists than Guides. The magnitude of the change in the attitudes of the Brownies after participating in the programme was also greater than those expressed by the Guides. It was concluded that that Brownies illustrated women scientists more often than Guides. In conclusion, the implications of these findings are considered in relation to the LTS programme and several suggestions for improvement are made.

METHODS

Subjects

As part of the Girl Scout programme, Brownies and Guides are community groups that provide young girls with opportunities to partake in games, arts & crafts and community service with their peers. Brownies ranged in age from 6-9 years of age while the Guides were between the ages of 9-12.

Four groups, of each Brownies and Guides, were randomly selected from those who had enroled in the LTS Scientist Badge Programme in the Greater London Area. Two groups of Brownies and two groups of Guides were randomly chosen to serve as the control groups while the remainider served as the experimental groups (Table 1). Experimental designation entailed completing the activity programme during the course of the study. The control groups completed the "drawing task" without participating in the science activities but had the opportunity to complete the activity session before the end of the academic year.

Materials

A "scientist scale", comprised of twelve stereotypical science indicators, was developed based on previously collected LTS Brownie and Guide drawings. Several of the indicators had also been previously used by Mead and Metraux (1957) and Chambers (1983). The scale was subdivided into the physical appearance of the scientist, their work environment and any notations or comments included on the drawing. The personal characteristics included: gender, age, glasses, lab coat and unhappiness. A traditional laboratory environment, including an element of danger or fire, a lone scientist, highly technical equipment and

chemicals were the indicators of a stereptypical "scientific" environment.

Pictures of "scientist" drawn by the participants were scaled with the stereotypical indicators receiving a negative score(0) and atypical markers receiving a positive score(1). Dialogue was scored as either positive(+1) or negative(-1) with the absence of any spoken comments receiving a neutral score(0). An example of a non-traditional drawing would have been a young(1), smiling(1), female(1) scientist wearing street clothes(1) working outside(1) without any signs of danger(1), and would have received 6 of the maximum 12 possible points. A score of -1 indicative of a completely stereotypical illustration.

Procedure

Experimental groups were visited one week prior to their participation (PRE) in the activity night and were asked to "draw a scientist". A conscientious effort was made to use gender neutral language when assigning the task. The same procedure was repeated one week following their completion of the activities (POST). An effort was made to pair the collected drawings of the subjects having participated in both the PRE and the POST samples. The control groups were visited over an identical time

period participants completed the drawing task without having participated in the activity programme in the interim.

Pictures were then scored by a non-biased individual and each picture received a score out of 12 attitudinal points. Total scores for each group, across Pre and Post conditions were analyzed using the SPSSPC+ 4.0 statistical package. The overall scores of the Brownies and Guides were compared using a MANOVA. An analysis of the differences between experimental and control groups was also included. An ANOVA analysis was conducted to isolate the effects of the programme on the Brownies and Guides independently.

In addition to the quantitative analysis, several additional sets of information provide insight into the success of the programme and the attitudes of the participants. Before beginning the hands-on component of the programme, LTS facilitators ask the participants a series of questions including: What is science? Do you know a Scientist? Do you want to be a scientist when you grow up? Participant responses to these questions were recorded on one occasion and provided insight into the participants' background and pre-programme scientific knowledge.

RESULTS

QUANTITATIVE

Using a MANOVA, Brownie and Guide groups were compared between Experimental/Control conditions and Pre and Post time periods and conditions (Table 1). Brownie and Guide groups were also evaluated independently using a one way analysis of variance procedure.

When examining science attitudes over all conditions (experimental and control) and time (pre and post), Brownies were found to have more positive science attitudes than the Guides [$F(1,89)$, $p<.00$]. Brownies also demonstrated greater changes in attitude over the Pre and Post conditions than did the Guides [$F(1,89)$, $p<.05$]; although, an independent analysis needed to be conducted to determine the locus of the change.

An independent analysis of the Brownie group isolated a significant difference between the attitudes of experimental Brownies versus the control Brownies. Post condition Brownie drawings depicted less stereotypical "scientists" [$F(1,49)=11.71$, $p<.001$]. Similar results were not found in the Guide groups, with a non-significant difference between the Pre and Post conditions.

A one-way ANOVA of the experimental groups evaluated the

shifts in science attitudes within each group (Table 2). The mean increases in positive attitudes of the Brownies (X=1.37) and Guides (X=.29) indicated that science attitudes amongst Brownies were significantly more affected by participation in the programme than the Guides [$F(1,46)=11.34$, $p<.002$].

In accordance with the majority of science attitude research the gender variable was isolated in order to determine the number of participants who held masculine views of scientists and science. Examination of the number of positive scores on the Gender Variable (Table 3) indicated that Brownie groups illustrated a greater number female scientist when averaged across pre/post and experimental/control conditions. Female scientists were depicted in 56 of the 102 (55%) drawings by the Brownies. Within the pictures by the Guides, only 34% of the 84 pictures collected featured female scientists.

QUALITATIVE

A Brownie control group was visited during their activity night, several weeks after completion of the final scientist drawing. At the beginning of the programme the facilitator asked the girls "What science was?" and "Who does science?". The respondents were knowledgable and enthusiastic and replied, "Science is discovering things", "inventing things", "blowing

things up". Popular science figures were named as scientists they new including Bill Nye 'the science guy', Dr. Bunsen Honeydew (The Muppets) and several cartoon characters. When the participants were asked if they personally knew a scientist, only one person responded that her uncle worked in a lab. Although the majority of scientists highlighted by the Brownies were male, they responded positively when asked if girls and women were successful scientists and could success in science.

A survey was also administered to the leaders of each of the groups during the initial visit. The majority of leaders (61%) had only completed science at the high school level and (21%) were employed in a science related field. An overwhelming number of leaders (95%) expressed an interest interested in gaining more information how to increase the quantity of science programming.

DISCUSSION

The Scientist scale, comprised of twelve stereotypical science variables, was used to compare and contrast the effects of age and participation in the Let's Talk Science Badge Programme on Brownies and Guides. Several significant findings were discovered as a result of the study 1) Brownies were found to have more positive science attitudes relative the Guides 2)

Brownies displayed a greater change in attitude over the course of the study relative to the Guides 3) Participation in the programme had a more significant impact on the Brownies 4) The number of female scientists depicted in the drawings was higher and increased more significantly post participation in the Brownie group.

Positive Brownie attitudes

When compared across all variables, Brownies (age 6-9) were found to have more positive attitudes towards science than Guides (age 9-12). In 1984, Scibeci conducted a comprehensive review of 200 attitudinal studies and concluded that as girls get older their positive attitudes towards science decrease. Substantiating the claim that girls develop more negative attitudes towards science as they progress through school, Koballa (1989) outlined a series of contributing factors including elementary school experiences. In 1988, Baker subsequently established that a bias, favouring male students, exists within elementary school system and perpetuated by elementary teachers. A greater perceived science ability in males leads to the exclusion or minimization of the active involvement of young girls within the elementary

science context. The communication of negative science messages contributes to the development of science "attitudes". The more positive attitudes of the Brownie groups in relation to those of the Guides can partially be attributed to the impact of the negative influences experiences within the school system.

Benefits of LTS on Brownie attitudes

As Girls increase in age, their scientist illustrations became more stereotypical in nature. Similar results were found in Boylan et al (1992). It is assumed that the Guides are more set in their perceptions of what a scientist is and how science relates to them.

In 1990, Hill et al. noted that attitudes towards science and science interests are generated on the basis of early childhood experiences. In addition, it was proposed that the majority of these attitudes are developed before reaching middle school. A general lack of interest in science amongst young girls (9-12) was attributed to less opportunities to participate in extracurricular science activities and hobbies than their male counterparts. Participation in science hobbies in early years has been implicated as a major factor in subsequent interest in science and potential career opportunities (Hill et al, 1990).

Perhaps a more long term programme or the inclusion of a presentation from a "credible" role model might in impact of the LTS activities.

Greater attitudinal change in Brownies

A student's affinity towards science and related activities decreases past third grade (Hill et al 1990). The average age of a Guide coincides with this third grade bracket. This serves as a possible explanation for fixedness of their attitudes in relation to their younger counterparts.

Insufficient academic support on the development of negative science self concept and attitudes of the young girls (Shepardson, 1990) also contributes to the fixedness of the science attitudes of the older girls. In 1987, Baker confirmed that due to a lack of previous science experiences, girls are often excluded or take a passive role in co-ed science class environments. Rand and Gibb (1989) also documented a lack of extracurricular science involvement in young girls in comparison with their male counterparts. Beginning at age 3, girls receive less access to science, and thus develop increasingly negative attitudes, throughout their formative years. This indicates that as girls increase in age their access to science decreases, and

in turn they are less apt to develop new attitudes towards it.

Female Scientist representations

One of the major barriers to female interest and participation in science has been the attitudes that it is a male dominated profession. Rand and Gibb (1989) collected drawings from school aged girls before and after they participated in a hands-on science outreach programme similar to LTS. Supporting LTS experimental Brownie results, Rand and Gibb's a greater percentage of participants illustrated female scientist after having participated in the programme.

There are several potential reasons why there was a greater number of women scientists represented in the Brownie group. The first is that Brownies have not been subjected to the intensity nor the length of media impressions of the "stereotypical scientist". Secondly, the majority of the role models that the girls have been associated with are female (mothers, baby sitters, elementary school teachers).

In Boylan et al (1992), kindergarten and first graders did not show significant stereotypes but appeared by grade 2. A possible explanation of this could be the increased prevalence of the media in North American culture that reaches children at a

younger age.

The significance of the impact of participation on the Brownies supports the notion that early science experiences are paramount in creating positive science attitudes. It is important to note that although there was not a statistically significant impact on the Guide groups, their involvement provided an opportunity to share a positive science experience that will create a greater awareness of science and scientific process.

CONCLUSION

Our society is inundated by a host of daily scientific messages: medical advancements, environmental catastrophes, new discoveries and decoding these messages requires a basic level of scientific literacy. Over the last decade, researchers have documented that the average citizen has a weak understanding of the science that surrounds everyday life. In order to break the cycle of scientific illiteracy, science and science related information must be communicated in different ways in order to reach the greatest number of people. One of the essential changes required to achieve this goal is the inclusion of all segments of the population within scientific disciplines and

professional domains. Rand and Gibb (1989) concluded that the experiencing the science in positive and active ways resulted in outreach programme participants expressing a greater understanding of what science is and how it affects their daily lives. Thus, outreach activity oriented programmes are essential in order to ensure that young girls have access to the opportunity to experience science.

Acknowledging the current under-representation of women and girls in science, the combination of governmental and educational support of outreach initiates like Let's Talk Science, will be an essential component in promoting science for everyone.

PROGRAMME IMPLICATIONS

There are several key factors that support the need for LTS and other science outreach programmes. The impact of early experiences on future and career decisions of young girls and boys (Simpson & Oliver, 1990), illustrates the need for providing young girls with positive introductions to science and scientists. By initiating positive hands-on science experiences, LTS serves to provide some of the positive encouragement that may not be present in schools and the family environment.

The following are commendations and proposals, based on personal observation and accredited research, designed to improve or support various areas of the LTS Brownie and Guide Scientist Programme. The use of undergraduates and the compostition of the facilitator groups is examined. In addition, the importance of parental involvement and the benefits of all female environments are highlighted.

Undergraduates as Role Models

Koballa (1988) concluded that undergraduate science students were not viewed as effective science role models. It has been hypothesized that this is due to a previous lack of familiarity and interaction between young girls and university students. An increased awareness of the role and tasks of undergraduate students may serve to increase their acceptability in the eyes of

participants; in turn, their ability to successfully promote science will be enhanced. There was also a significant relationship between science attitude and the personal contact with an authentic scientist (Baker 1989). Providing access to science students via LTS serves to increase the personability of science.

Rand and Gibb (1989) also highlighted the importance of having female instructors for the programme. In support of the LTS teams comprised of both men and women, Koballa (1988) documented that the most successful promoters of science were parents and female science teachers. In older girls, for example the Guide groups, male high school students. This indicates that perhaps the presence of a male demonstrator is a positive influence on the attitudes of the girls.

Parental Involvement

Rand and Gibb (1989) outlined the importance of parent and teacher involvement in science programmes geared for young girls. Perhaps the inclusion of parental involvement on the night of the LTS science activities would have a positive effect of providing a long term influence on both the individual and their family.

All Female Environment

Omerod (1981) supported the beneficial influence of science education within all female schools. This provided evidence for the necessity of encouraging and teaching science in all female environments in order to increase positive attitudes toward scientists and science careers. Perhaps the exclusion of men from the undergraduate teams might increase the accessibility of the programme in the eyes of the participants. In addition, the benefits of conducting the programme within the all female groups are apparent and should be continued.

Future Research and Programme Opportunities

By expanding the programme into Boy Scout groups, three goals will be achieved. The first will be an increase opportunity for the children to become actively involved in "science". The second will be an opportunity for the boys to be exposed to female science undergraduates, which will in turn increase their awareness of the importance or existence of female scientists. The third off beneficial aspect of the programme will be the opportunity to evaluate differences between the impact of LTS on boys versus girls.

An exploration of the science backgrounds of the Brownies

as portrayed in their drawings. In addition, an attitudinal drawing completed several weeks after completion of the Post drawing would indicate the long term value of the programme.

Acknowledging the lack of success in engaging Guides in a measurable shift in science attitude, exploring the inclusion of a "credible" guest speaker might prove to be beneficial.

LIMITATIONS

There were several factors that limited the effectiveness this study. The measurement of the science histories of the participants would have provided supportive insight into their pre-participation attitudes. This would have enhanced the validity the interpretations of the effect of the programme. A longer period of evaluation or an additional set of drawings collected several weeks after the last drawing task would be indicative of the long term effects of the programme on the attitudes of the participants. Ensuring that all participants in the first drawing task were present throughout the second task would have increased the sample size and thus improved the statistical validity of the study.

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APPENDIX

TABLE 1

	BROWNIES		GUIDES	
	PRE	**POST**	**PRE**	**POST**
EXPERIMENTAL	5.93	7.30	4.91	5.62
CONTROL	6.46	7.54	5.19	5.71

Average mean scores of Brownies and Guides on the "Scientist" scale.

FIGURE 1

BROWNIE AND GUIDE PACK LEADER QUESTIONNAIRE

This questionnaire was completed by 20 pack leaders. The results are interpreted collectively due to little variance between the responses from Brownie and Guide Leaders.

Q1. Last level of completed formal science education:

*high school 11 (61%)
*college 4 (22%)
*university 3 (16%)

Q2. Work in a science related field:

*yes: 4 (21%)
*no: 15 (79%)

Q3. Frequency of science activities in Pack programming:

*never: 1 (6%)
*sometimes: 15 (88%)
*often: 1 (6%)

Q4. Science activities included in programming:

*guest speakers: 6
*field trips: 16
*health/fitness: 11
*arts & crafts: 14
*environment: 7

Q5. Personal Science Participation:

	NEVER	OFTEN	SOMETIMES
read journals/newspapers/books	1	15	5
watch TV programmes		15	4
science hobby	9	8	3
discuss with family/friends	4	15	2

Q6. Importance of encouraging young peoples' participation in science related activities?

*extremely: 17(89%)
*somewhat: 2(11%)
*not very: 0

Q7. Interest in learning more about science and how it can be incorporated into programming:

*yes: 19 (95%)
*no: 1 (5%)