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ABSTRACT

This study, part of a larger research project, explored the knowledge and attitudes of the general population regarding cloning. Such awareness of the general public's knowledge of important science topics, attitudes toward such topics, and sources from which people retrieve information can help scientific and educational communities develop strategies that foster higher levels of scientific literacy among the public. The sample population contained 156 individuals, 76.3% of which were associated with a college or university. Twenty-five occupations were represented including teachers and students. Results indicated four themes: (1) attitudes toward cloning were not correlated to gender; (2) occupation and academic association were strongly correlated to attitudes; (3) respondents were concerned about cloning and comments indicate that this pattern may be grounded in a concern about control rather than the need for more research; and (4) respondents who felt that more research was needed had a significantly negative correlation to attitudes toward research on animals, human cells, and bacteria. Likert Scale responses are included in the appendix. Contains 30 references. (PVD)

CLONING:

What Are Their Attitudes?

A Report on the General Attitudes of a Sample of Midwestern Citizens

Presented at the Annual Conference of the

National Association for Research in Science Teaching (NARST)

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Introduction

The topic of cloning, once a theme for science fiction novels, has entered the mainstream of scientific literature and human life. In the United States congressional legislation is pending and President Clinton is proposing a five year ban on human cloning. Dr. Seed is promising future parents the possibility of cloning their children. Television and other forms of media also introduce cloning into story lines and talk shows. And finally, recent successes in genetic engineering involving multicellular organisms has brought human cloning into the "realm of the possible" in the approaching decades.

Cloning entered the daily conversations of the general population with the publicity surrounding molecular biology's technology used by I. Wilmit et al (1997) in the cloning of a sheep named Dolly. Wilmit's work was intended to be used as a tool for animal husbandry and the development of sheep that could produce useful proteins in their milk. But does the general public realize this use for genetic technology? Marker (1993) discusses how technology expands our policy options and how public policy, which is controlled by humans, does make a difference in how we develop and use such innovations. In our capitalistic society, the responsibility of the possible effects, positive and negative is not placed in the hands of vendors who profit from such technology. This reiterates the need for an educated and scientifically literate population of citizens. Citizens should have information regarding the capabilities and possible abuses of such advances in this area of biotechnology.

This discussion in science education has gained importance in recent reform efforts under the label of "scientific literacy." Literacy generally implies a set of cognitive, affective, and behavioral outcomes needed for a citizen to live in our technologically oriented society (Welch, 1985). Hurd (1958) first used the phrase scientific literacy" to describe an understanding of science and its applications to our social experience. In their guidebook to active meaningful science learning, the Midwest Consortium for Mathematics and Science Education (1994) states that scientifically literate citizens will be able to understand key concepts of science and technology, use this knowledge in everyday life, understand complex policy issues, and grasp the complexities of rapid change. There is a growing recognition that in the industrialized world scientific literacy is an important component of long-term economic growth and of effective citizenship. However, studies have indicated that relatively few citizens in the United States and other nations understand basic scientific terms or can make sense of conflicting arguments from experts on science issues relevant to society (Miller, 1989). Cutliffe (1990) has stated that "science and technology are complex enterprises taking place in specific social contexts shaped by and in turn shaping, human values as reflected and refracted in cultural, political, and economic institutions." In these references to scientific literacy, we see the importance of the cognitive domain of science knowledge, as well as the affective domain encompassing attitudes toward science. This study explored the knowledge and attitudes of the general population regarding cloning. It also sought to discover where people gather information on cloning. The investigators explored such questions in an effort to begin to develop a clearer understanding of the knowledge level, attitudes, and resources that help people gathering information and form beliefs.

Theoretical Framework

In today's rapidly advancing technological world, the products of technology along with their sociological and environmental implications, are essential features of daily life

(Hofstein & Yager, 1982). It is becoming increasingly important for citizens to keep pace with recent advances in science and technology. Bybee (1985) states that citizens have a genuine need to understand the impact of science and technology on society and the social issues they must evaluate. This is important since a population's misunderstandings of science can impact the political process and influence a wide range of issues from funding for scientific research to misguided regulations and unrealistic expectations (Prewitt, 1983). It is important for citizens to be able to apply scientific knowledge and technical vocabulary when considering social-scientific problems or issues (Wraga & Hlebowitsh, 1991).

Knowledge of cloning encompasses a wide range of topics. Biotechnologists are involved in environmental concerns such as those dealing with herbicides, disease prevention, creating specialized or designer genes (especially in plant and bacterial organisms), experimenting with biological catalysts and enzymes, developing agricultural products, as well as research involving nitrogen fixation, monoclonal antibodies and viruses. These areas of research are seldom mentioned. All of these research efforts involve cloning or processes that require cloning. Biotechnology efforts have contributed to the identification and isolation of specific proteins which can be utilized to fight disease, increase agricultural yield, and for culturing new tissues (Skena, 1992). Knowledge of cloning then, should include an understanding of some of these applications, and not merely focus on future implications.

Where do people acquire their knowledge on biotechnology issues and specifically cloning? The general population acquires knowledge in a variety of ways. Part of this learning is in traditional settings, but a major portion also is from informal sources. Such sources can include: popular periodicals, television news broadcasts, news shows, the internet, and from others. Marien (1985) argues that adult learning of science or scientific literacy is necessarily an informal learning process. For even the most comprehensive formal education cannot possibly equip an individual for a scientifically literate lifetime (Hacker & Harris, 1992).

For a scientifically literate populace capable of making informed decisions about cloning, people must be knowledgeable about basic genetic and biological concepts. One difficulty in this area is the jargon and technological verbiage utilized in the media to describe cloning and genetics. People are intimidated by "genetics related terms" used to describe processes. In one Time magazine article related to bioethics, 64 terms (ranging from polymorphism to nitrogenous bases) were used to describe the chemical and biological processes. Often the general public uses these resources as a significant source of science information (Mertens & Hendrix, 1990).

This study also investigated people's attitudes toward cloning. McCormack (1992) states that new perspectives on learning offer central places for both thinking skills and knowledge, and also give appropriate recognition to the domains of attitudes, creativity, and applications. In the last few decades we have witnessed a shift in the educational system from one that emphasized on the cognitive outcomes of education to one that places equal emphasis on affective outcomes (MacMillan & May, 1979). This shift stems from the belief that affective variables are as important as cognitive variables in influencing learning outcomes and behavioral outcomes. This study sought to explore of the ethical, moral, and political dimensions of the people regarding the issues of cloning.

Significance of this Study

Although people are being presented with scientific topics in the news daily, very little learning appears to be occurring from such exposures (Shamos, 1990). Studies have

shown that there is a negative attitude toward science among the general public (Ford & Tebbutt, 1993). This attitude is particularly evident among women. Many adults do not consider careers in science and technological fields as a result of these attitudes. There is a greater need for scientifically literate people (Bracey, 1997) because the world is becoming increasingly more technologically and scientifically dependent. Adult literacy in these areas influences decision-making and issues that impact everyone.

This also involves the issue of not only attitude measures but also, sources of scientific information. Where do people get information on scientific topics? How can the educational and scientific communities best serve the public and their needs? The educational and scientific communities in the United States have been searching for ways to advance general scientific literacy for everyone in response to the publication of *Science for All Americans.*

Hacker & Harris (1992) state that most adult learning is informal learning and that any research into adult science learning must concern itself with informal styles. The popular media is often the source of science information. Repeated media attention given to some of the topics, such as the harmful effects of ultraviolet light on the skin and energy conservation, can contribute to the common culture of literate adults. Shamos (1990) and Griffin (1989) found that adults are likely to recall science facts that have been presented to them repeatedly in the media.

Such an awareness of the general public's knowledge of important science topics, their attitudes toward such topics, and the sources where people retrieve their information can help the scientific and educational communities develop strategies that foster higher levels of scientific literacy among the general population.

Methodology

This study was based on both quantitative and qualitative data gathering methods. It examined the relationships between demographics and knowledge of cloning, attitudes toward cloning, and sources of information on cloning/cloning issues. The survey was initially developed over the summer of 1997 and field tested, evaluated, and revised. It consisted of eighteen items, most of which were Likert scale or multiple category response items. One item was a free response question that initially asked participants to define "cloning" The initial survey instrument was field tested with a sample of thirty individuals and was found to be statistically reliable. The instrument included four items designed to assess knowledge of and uses of cloning, three items on the sources of information on cloning research, and twelve items on attitudes toward cloning research.

The results were analyzed using the SPSS Base 7.5 for Windows software. Correlations included Spearman and Pearson correlations, as well as the use of crosstab and descriptive statistical features. Items were analyzed in relationship to the demographic information, as well as, to the specific elements of knowledge, attitudes, and sources of information.

Qualitative data was also gathered from follow-up interviews and from the open-ended item that asked: "What do you think cloning is?" The follow-up interview participants were selected from among those who completed a survey and gave their first name and phone number to be contacted for a possible interview. Eight individuals were successfully contacted and given follow-up interviews. The interviews asked participants questions on the following areas of cloning and cloning research:

-their definition of cloning;
-where they would obtain factual information on cloning;

-whether they considered themselves knowledgeable enough to make informed decisions about cloning and cloning research;
-where they learned about cloning or cloning research recently;
-what they thought the greatest benefit (if any) of cloning; and,
-what their greatest concern was about cloning.

The interview data was then coded and compared to that obtained from the surveys. The responses to individual interviews were analyzed by teams of investigators involved in one of the three areas of exploration: knowledge, attitudes, and sources of information.

A team of ten researchers helped distribute and collect surveys from college campuses in the Columbus, Ohio area, from local business and clerical offices, and from public gathering places. Investigators exercised care to assure that participants were randomly selected. Demographic information allowed researchers to attempt to contact as many individuals from different backgrounds, age groups, and educational levels.

Another important part of this survey was the attempt to administer it on a person by person basis. It was not intended to be administered without the guidance of one of the investigators. Thus, assuring that the participants would take greater care and seriousness than might otherwise have been given.

Demographics of the Research Sample

The sample consisted of 156 individuals. Males made up 41.9% of the sample and females 55.5%. The ages of the participants were: 18-23 years 17.8%, 24-29 years 21.5%, 30-34 years 14.7%, 35-39 years 13.6%, 40-44 years 8.4%, 45-49 years 3.7%, 50-54 years 3.7%, 55-64 years 7.3%, and 65+ years 5.8% with 3.7% of respondents not giving their age.

Of the participants, 76.3% were associated with a college or university and 20.5% were not. There were 37 different college degrees represented as well as 25 different college majors. 29.5% of the respondents indicated that they had completed some college level courses, 12.8% had a two year college degree, 17.9% had a four year college degree, 8.3% had completed some graduate level work with 15.4% having completed a Masters degree, 1.3% having completed a professional degree, and 1.3% having completed a Ph.D. degree. A further 0.6% had only completed education through the 11th grade and 9.0% had completed through the 12th grade.

Of those indicating that they were on the faculty at a college or university, there were 8 different faculty departments represented. There were also 25 different occupations represented including teachers and students. This sample was drawn from 13 different locations of which there were 6 different institutions of higher learning represented.

Overview of Specific Survey Items on Attitudes toward Cloning

The advent of any scientific or technological advancement is meant with an outpouring of mixed reactions from the populace. These reactions often take the form of attitudes toward the specific topic. The topic of cloning is certainly an exemplar case for these public attitudes. Koballa (1988) stated that attitude is considered "a learned predisposition to respond in consistently favorable or unfavorable or unfavorable manner toward an attitude object " (p.116). Koballa goes on to state attitudes, mediated by values, determine the individual's behavior intentions which influence how the person actually behaves toward the object. Currently, the belief is that affective variables are as important as cognitive variables in influencing learning outcomes, career choices and the use of leisure

time. During the past few decades, we have seen the focus of science education changing from one of producing an elite minority of scientists, technicians and engineers for industrial growth to one of promoting scientific literacy and critical thinking ability among the whole population (Brophy and Pillay, 1986). This highlights the importance of the attitudes of the general population toward science and recent advances in scientific technology.

Payne (1977) stresses the role of positive attitudes in responsible citizenship. Positive attitudes lead to interest in scientific and technological matters which provide citizens with important background in participating and acting on issues of social concern involving science and technology. Recent advances in cloning and the subsequent issues of social concern raised by these issues highlight the importance of understanding the general population's attitudes toward cloning. Positive attitudes engender a tendency to delve deeper into the underlying issues and gather information to make rational decisions about issues that affect society and the environment (Hariharan, 1997).

To study the attitudinal issues of cloning, the survey posed two types of questions. One was a Likert Scale and the other was multiple responses. The other question was a one response question of "Yes", "No", and another response such as "It Depends or "Unsure". There were no forced choice responses in the survey and the respondents were given the option of responding "It Depends" or "Unsure". A qualitative interview component was also employed as a follow up to the main survey. The purpose of these interviews was to gain an understanding of the reasoning behind some of the responses to the main survey.

Data Analysis of Attitudes toward Cloning

Likert Scale Questions

The Likert Scale response were analyzed using SPSS 7.5 (SPSS Inc., 1996). Crosstabulations were used to determine the frequency of the responses for each of the choices: Strongly Disagree (SD) Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA).

(See Appendix for Responses to Statements about Cloning)

The respondents to the statement "I am optimistic about where people are heading with recent advances in cloning technology." were evenly distributed between the respondents disagreeing, agreeing, and neutral after collapsing the Strongly Disagree and Disagree categories and the Agree and Strongly Agree categories. The results were as follows: 35% Disagree (SD and D); 32% Neutral; 34% Agree (A and SA). This indicates that the population is evenly split with regard to their optimism about the future uses of cloning technology. At the same time a large portion (approximately one-third) of the people were unable to have an opinion on the subject points toward the possible lack of sufficient information to formulate an opinion on the subject.

Almost half of the respondents were in agreement with the statement "Cloning will benefit society." The responses were as follows: 26% Disagree (SD and D); 28% Neutral; 46% Agree (A and SA). The higher proportion of respondents in agreement with this statement versus the proportion expressing optimism about the future of cloning points to an underlying belief in the usefulness of this technology inspite of concerns about possible future uses of the technology. This is reflected in responses to the statement "I am concerned about recent advances in cloning technology" to which the majority of the respondents were in agreement. The responses were as follows: 18% disagree (SD and D);

21% Neutral; 60% agree (A and SA). This attitude of concern over the possible misuse of cloning technology was also manifested during the follow-up interviews where a recurring theme was concern over the misuse of cloning technology as a means to harvest human body parts.

The statement "Cloning is equivalent to playing God" elicited relatively few neutral responses. The response were as follows: 41% disagree (SD and D); 21% Neutral; 38% agree (SA and A). Thus even though relatively fewer respondents expressed a neutral attitude toward this statement, the rest of the population surveyed was evenly divided in their agreement to the statement. One respondent, in a follow-up interview evidenced concern about the fact that since human beings can now create other living things, they may begin to believe that they are more powerful than God and this does not bode well for the human race.

Responses to the statement, "I would use a product made by cloning" were evenly distributed in the population sampled. They were as follows: 33% Disagree (SD and D); 33% Neutral; and 33% Agree (SA and A). Thus only 1/3rd of the population sampled had a positive attitude toward their possible personal use of the products of cloning technology. The follow-up interviews too, indicated an inability to identify specific examples of possible positive uses of this technology.

The data were also analyzed for relationships between attitudes and demographic characteristics that included sex, education, occupation, academic association, and age. The following relationships were found to be significant using the Pearson correlation.

Analysis of the responses to the statement "I am optimistic about where people are heading with recent advances in cloning." Indicated a correlation to Occupation (.-254) and Academic Association (.-222) at the $p = .01$ level.

Analysis of the statement "Cloning will benefit society." indicated a correlation to Occupation (-.347) at the $p = .01$ level and Academic Association (-.174) at the $p = .05$ level. ."

Another to correlation with Occupation (.156) and Academic Association (.178) at the $p = .05$ level was seen in response to the statement "I am concerned about recent advances in cloning technology."

Responses to the statement "Cloning is equivalent to playing God." showed a correlation to Level of Education (-.264), Occupation (.331), Academic Association (.244) at the $p = .01$ level and Age (.181) at the $p = .05$ level.

No significant correlation was observed in response to the statement "I would use a product made by cloning."

The highest correlation between these questions occurred with the statement "I am optimistic about where people are heading with recent advances in cloning." The correlation with "Cloning will benefit society." (.681) and "I would use a product made by cloning." (.738) at the $p = .01$ level. Thus the data indicate a strong correlation between level of education, academic association and occupation to respondents' attitudes toward the benefits and uses of cloning technology.

One Response Questions

An overwhelming 42% of respondents believed that research should not be conducted on cloning as compared to 28% who believed that it should be and 30% who were unsure. The only significant correlation of these responses was with Academic Association (.198, p=.01 level). It is important to note here that the term research was loosely used with no specific mention of research on any specific type of organism or cells. The respondents that answered "Yes" to whether research should be conducted on cloning were further probed as to their opinion about the entity that research should be conducted on. Of the respondents in favor of cloning research, 69% thought that research in cloning should be done on plants, 55% on animals, 54% on bacteria, 33% on human cells, and 9% on humans.

The significant correlations that emerged using the Pearson Correlation were as follows:

Attitude toward research on animals was correlated to Gender (-.253, p=.01 level) and Occupation (-.194, p=.01 level).

Attitude toward research on bacteria was correlated to Gender (-.174, p=.05 level).

Attitude toward research on human cells was correlated to Gender (-.170, p=.05 level); Occupation (-.170, p=.05 level); Academic Association (-.224 p=.01 level) and Age(-.217, p=.01 level).

Thus the predominant correlation with attitude towards research appears to be with the variable of Gender.

With respect to whether cloning should be taught in school, an overwhelming 62% believed that it should be as compared to 26% who believed that cloning should not be taught in school and 9% who responded ?It Depends?. Of the 62% who believed cloning should be taught in school, 9% believed it should be introduced in the elementary grades, 15% in middle school, 31% in high school, and 19% in college. Thus the majority of the respondents who believed that cloning should be taught in school also believed that it should be introduced when students are old enough to comprehend it fully during their high school and college years.

When asked to respond to what should be taught regarding the subject of cloning: ethics, facts, techniques, or future, 81% of respondents expressed the opinion that Ethics should be taught, 74% wanted facts to be taught, 51% were in favor of teaching techniques, and 62% thought that the future of cloning and cloning technology should be taught. The same concerns with the ethical implication of advances in cloning technology were seen in the follow-up interviews with respondents.

The Interviews

The respondents reporting the greatest benefit and their greatest concern about cloning revealed some interesting results. In addition to their results, the manner in which they approached the interview was significant. Four of the respondents declined to be interviewed on tape. In the member check, they were emphatic about not being associated with their responses.

Most of the responses to the benefits of cloning centered around the possible medical applications of this technology. A common example cited was its possible use in organ transplants and medical research. Another example given was the use of cloning in the production of more food thus helping the human race fight starvation. Some respondents who cited medial uses as a possible benefit of cloning technology, however were unable to give any specific examples of that these medical uses might be.

The greatest concern expressed about advances in cloning technology centered around the control of it. Respondents were concerned about the technology falling in the wrong hands and being used for self-serving purposes leading to destruction instead of for the benefit of the human race. Concern was also expressed about governments controlling it and using the technology for their own interests. Other concerns expressed involved the cloning of humans including the cloning of human armies and the commercialization of science as in the cloning of dead pets.

The respondents had difficulty in naming the benefits of cloning and often responded with concerns even when asked the question regarding benefits as seen in one response: "I think it could be dangerous,...livestock, botanical plants, botany, it could be a dangerous potential for good and bad."

Emergent Themes and Patterns

In this study and for this population, four themes emerged. Gender was not an indicator of attitudes toward cloning. In other words, attitudes toward cloning were not correlated to gender. This is what one would expect.

The second emergent theme was occupation and academic association were strongly correlated to various attitudes toward cloning. These characteristics often determine opportunities for individuals to access sources information and opportunities for peer interaction. Occupation and academic association showed significant positive correlation for cloning especially toward benefits and optimism.

Third, the respondents were concerned about cloning (60% agree) but this concern was not connected to the need for more research (42% no). This pattern may be grounded in the concern of control on the cloning issue referred to by the comments "Governments will have their own interests.", "...got into the wrong hands" and "commercialized science".

Fourth, the respondents who did feel that more research was needed had significantly negative correlation to attitudes toward research on animals, human cells, and bacteria. This negative response toward research on bacteria is better understood in view of interview responses listing "germ warfare", and "perfecting destruction" as possible uses of cloning. The negative response to human cells is also expected with the expressed concern of "artificially adding people." However, it does not correspond to responses indicating the medical uses for cloning in areas such as cancer research and organ growing for transplants. The negative attitude toward research on plants could be attributed to lack of awareness of the current uses of cloning technology in the agriculture industry. Animal cloning was also probably not considered as a possibility for food production. Perhaps the negative attitude to research on animals was the result of the media coverage on "Dolly" that served as a focus for respondents' attitude on cloning in general.

Implications for Future Research

Several areas of this research need further study. One is the relationship between the concern about cloning and the need for additional research. The sample of convenience

employed in the methodology may have an impact on the responses. That may account for the high correlation with occupation and academic association. It would be interesting to conduct a random sampling of the population to compare the results and see if the same correlation exist. Also beneficial would be in-depth interviewing with a large sample of people to probe into underlying causes of peoples? attitudes toward cloning. Another research possibility is in-depth research on how use of different sources of information and individual interest in seeking out more information affects attitudes toward cloning. In addition, comparison of the concerns of the scientific community and the lay population with respect to advances in cloning technology could yield interesting results.

Appendix

Responses to Statements about Cloning (Numbers are percentages)

	SD	D	N	A	SA
Optimism	20	15	32	24	9
Benefit	18	8	28	37	9
Concern	6	13	21	33	27
God	16	25	21	33	25
Would Use	26	7	33	25	8

SD=Strongly Disagree
D=Disagree
N=Neutral
A=Agree
SA=Strongly Agree

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