Traits of Life Front-end Evaluation: Study 'A' Testing Specific Commonalities ("Can You Think of a Living Thing Which…")

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1. Introduction

This report describes Study A, the first of two studies that constitute the front-end evaluation for the "Traits of Life" project, conducted in August 1999.

2. Goals

The goal of the front-end studies was get a sense of what visitors believe to be the commonalities (if any) among all living things. The goal of this particular study was to find out whether visitors could think of counter-examples to seven true commonalities identified by the Traits of Life team. The results would reveal how familiar visitors were with these key commonalities identified by the team. Also, any exceptions frequently suggested by visitors would be identified as intriguing organisms to use in the exhibits.

3. The Interview

The interview was comprised of 11 questions and 2 sub-questions. Each question began with the phrase, "Can you think of a living thing which...", and was followed by a commonality. Seven of the questions were created directly from the list of commonalities chosen by the Traits of Life team. There were also four "dummy" questions (italicized below) in the survey; these were included in an attempt to ensure that all visitors would be able to answer at least some of the questions. The two sub-questions (indented below) were created after piloting the instrument and finding that many visitors did clearly did not understand what the commonality in question was.

Below are the interview questions in the order that they were asked:

Can you think of a living thing that doesn't have legs?
Can you think of a living thing that doesn't eat?
Can you think of a living thing that isn't made of cells?
Can you think of a living thing that doesn't depend on water?
Can you think of a living thing that doesn't contain DNA?
    When I talk about living things containing DNA what does "DNA" mean to you?
Can you think of a living thing that doesn't have organs?
Can you think of a living thing that doesn't start as a single cell?
Can you think of a living thing that doesn't have any kind of skin or membrane around it?
Can you think of a living thing that doesn't need light?
Can you think of a living thing that doesn't contain proteins?
    When you think about a living thing containing proteins, what comes to mind?
    How do you think about that?
Can you think of a living thing that doesn't keep its shape?

Whenever a visitor could not think of a counter-example, the interviewer asked, "So, do you think that all livng things have [common trait] or do you think there are some that don't but you just can't think of any right now?" Depending on their answer to this question, they were coded as, "no, all living things have [common trait]" or, "can't think of any."

4. Methods

A total of 40 people aged 10 and over were interviewed between July 11, 1999 and July 24, 1999. The interviews were conducted between 11:30 AM and 4:30 PM. Of the 40 interviews, 10 were conducted on a weekday and the remaining 32 were conducted on weekends. 15 of those interviewed were children (age 10–16), and the remaining 25 were adults. 18 males and 22 females were interviewed. 4 out of 40 participants spoke English as a second language.

The interviews were conducted under the skylights next to the Exploratorium café. Interviewees were chosen by a systematic sampling process. The typical interaction lasted approximately 10 minutes.

Responses were recorded verbatim. Upon conclusion of the data gathering, the responses were coded and patterns were identified.

5. Detailed Findings

The detailed findings are listed in Appendix A and Appendix B.

Appendix A summarizes the responses to each question in pie chart form. The sub-questions are in bar graph form and follow the primary questions they are related to. There

are three pie charts for each question asked. The first combines the answers of adults and children (n=40), the second contains only the adults' answers (n=25), and the third, the children's answers (n=15).

6. Summary of findings

Cells

A large majority of adult visitors (80%) said they believed all living things are made of cells. Approximately half of the children visitors (53%) said the same thing. A majority of adult visitors (57%) and a minority of children (20%) said that they believed all living things *start* as a single cell. Counter-examples given by visitors included plants / trees, and starfish growing from one arm. Several counter-examples revealed visitors' different interpretations of the question, in terms of what moment constituted the "start" of life. For example, two children visitors took birth as the start of life, while three other visitors took the moment before fertilization, saying that humans start out as a sperm and an egg.

DNA

A majority of adult visitors (68%) said that they believed all living things contain DNA. If we include as correct those who said viruses were counter-examples (because we later learned that some viruses contain RNA rather than DNA), the figure rises to 88%. Among children, 27% said that all living things contain DNA. When asked to elaborate on what they understood by "living things contain DNA," most adults (52%) talked about the distinct identity of an organism, or the idea of a blueprint or code. Among children, the most common elaborations of DNA involved blood (40%). We speculate that children's frequent connection between DNA and blood may be partly due to the current popularity of the "Animorphs" stories about shape-changers who have changeable DNA in their blood. Another possibility is that children were making connections to the O.J. Simpson trial, which was explicitly mentioned by two adults.

Proteins

Only 38% of adult visitors and none of the children said they believed that all living things contain proteins. When elaborating what they understood by proteins inside organisms, 32% of adults and 60% of children talked about protein as a food source that is eaten by living things; this was the most common elaboration made by visitors overall. Only 36% of adults and 7% of children talked about proteins as being located inside cells.

Skins & membranes

A majority of both adults and children (68% and 54% respectively) said that they believed all living things were surrounded by a skin or membrane. Many added that this was necessary for protection or for holding the organism together or keeping its form.

Shape

None of the 40 visitors said they believe that all living things keep their shape. Among adults, the most commonly given counter-examples were single-celled or amorphous organisms such as amoebas. Among children, metamorphosing organisms such as butterflies or tadpoles were the most commonly suggested.

Water
A large majority of adult visitors (80%) said that they believed all living things depend on water. Among the children, 33% said the same thing. The most commonly suggested counter-examples were insects and plants / animals found in dry habitats.

Overall comments
We were surprised that our sample of adult visitors were so familiar with many of the commonalities we presented, especially given that the form of the question asked visitors to think of a counter-example rather than agree with a commonality. Only two out of seven characteristics were not regarded as common to all living things by a majority of adults. In one case ("keeping its shape"), we suspect that our wording was too broad for the focus we wanted. It might be useful for the Traits team to realize that there are many ways to interpret this phrase. In the other case ("containing proteins") we think the data show that most of our visitors really do not recognize the fundamental role of proteins as common structural elements in living things.

7. Acknowledgments

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Appendix A:
Data summaries for all interviewees, for adults, and for children

The answers to each question are summarized in three pie charts:
• All interviewees (n=40)
• Adults aged 17 and over (n=25)
• Children aged 10-16 (n=15)

The answers to the two subquestions (asking visitors to define DNA & proteins) are summarized in the form of three bar graphs. The total number of responses to these subquestions is more than 100% because some visitors gave multi-faceted responses.

List of questions (excluding "dummy" questions)

Can you think of a living thing that isn't **made of cells?**

Can you think of a living thing that doesn't **depend on water?**

Can you think of a living thing that doesn't **contain DNA?**

When I talk about living things containing DNA, what does "DNA" mean to you?

Can you think of a living thing that doesn't **start as a single cell?**

Can you think of a living thing that doesn't have any kind of **skin or membrane** around it?

Can you think of a living thing that doesn't **contain proteins?**

When you think about a living thing containing proteins, what comes to mind? How do you think about that?

Can you think of a living thing that doesn't **keep its shape?**

Coding Note: Whenever a visitor could not think of a counter-example, the interviewer asked "So, do you think that all living things have [common trait] or do you think there are some that don't but you just can't think of any right now?" Depending on their answer to this question, they were coded as, "no, all living things have [common trait]" or, "can't think of any."