Cognitive Psychology 57 (2008) 1–19

Contents lists available at ScienceDirect

Cognitive Psychology

journal homepage: www.elsevier.com/locate/cogpsych

Folkbiology meets microbiology: A study of conceptual and behavioral change

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ARTICLE INFO

Article history:
Accepted 18 March 2008
Available online 23 May 2008

Keywords:
Folkbiology
Knowledge enrichment
Conceptual change
Behavioral change
Causal mechanism
Infectious disease
Germs
Colds
Biology
Coherence

ABSTRACT

Health education can offer a valuable window onto conceptual and behavioral change. In Study 1, we mapped out 3rd-grade Chinese children's beliefs about causes of colds and flu and ways they can be prevented. We also explored older adults' beliefs as a possible source of the children's ideas. In Study 2, we gave 3rd- and 4th-grade Chinese children either a conventional cold/flu education program or an experimental "Think Biology" program that focused on a biological causal mechanism for cold/flu transmission. The "Think Biology" program led children to reason about cold/flu causation and prevention more scientifically than the conventional program, and their reasoning abilities dovetailed with their mastery of the causal mechanism. Study 3, a modified replication of Study 2, found useful behavioral change as well as conceptual change among children who received the "Think Biology" program and documented coherence among knowledge enrichment, conceptual change, and behavioral change.

1. Introduction

Health education about common infectious diseases can offer a valuable window onto conceptual and behavioral change. When children catch infectious diseases, they are likely to wonder why and how they got sick. But since the culprits (i.e., fungi, bacteria, viruses) are too small to see, children are likely to come up with explanations based mostly on things they are able to observe as well as

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0010-0285/$ - see front matter
doi:10.1016/j.cogpsych.2008.03.002

things they hear other people say. If these intuitive ideas differ from what they later learn in health or science classes, will that new scientific knowledge actually change their intuitive biology and behavior? To address this question, we will first take a look at three sources of ideas in turn—children's intuitive biology, cultural learning, and science education—and how the ideas may interact to bring about conceptual change and possibly behavioral change as well.

A foundational theory—be it intuitive or scientific—outlines the ontology in a domain. For example, animals and plants are fundamental categories in (folk)biology, whereas minerals and artifacts are not. Children begin to grasp such ontological distinctions quite early on (e.g., Backscheider, Shatz, & Gelman, 1993; Hickling & Gelman, 1995; Keil, 1994). While children cannot see germs directly, they often hear adults talk about killing germs. In principle at least, they could infer from such remarks that germs can live and die like plants and animals (Harris & Koenig, 2006). Indeed, by age 5, children do say that "germs will die someday" and "germs can grow bigger." (The second statement, of course, goes too far. While fungi can grow bigger, bacteria can do so only marginally, and viruses clearly cannot.) The age at which children begin to draw such inferences can vary substantially across cultural or socio-economic backgrounds. In one study, Latino children from very low income families lagged behind children in a university lab school by 2 or 3 years (Au & Romo, 1996).

A foundational theory should also specify basic causal devices in its domain (e.g., Wellman & Gelman, 1997). Do children use such devices to explain biological phenomena? In one study, about 100 children (age 5–13) were asked to explain why they thought there would be more germs in some wrapped-up leftover dinner after it sat out on the dining-table overnight (Au & Romo, 1999). None of them mentioned germ reproduction (e.g., "Germs breed in food"). Instead, they talked about germs getting in through cracks in the dish, bugs carrying germs to the food, germs in the air inside the wrapped dish landing on the food, etc. Their causal mechanism of choice usually involved mechanical processes (i.e., how germs move or are moved around), rather than biological ones (e.g., reproduction and death of germs).

Perhaps this should not come as a surprise. From infancy on, children learn more and more about how objects and substances move and interact physically (e.g., Carey & Spelke, 1994; Wellman & Gelman, 1997). Stretching a well-worked-out intuitive theory—in this case, naïve mechanics—to reason about biological phenomena is quite understandable. Even adults across cultures recruit their naïve mechanics to explain links among causes, symptoms, and treatments of illnesses such as gastrointestinal problems, breast cancer, and high blood pressure (e.g., Au & Romo, 1999; Garro, 1988).

Cultural learning is another source of ideas for children. For instance, it is widely believed across cultures that people catch colds and flu by getting wet and/or by getting cold (e.g., Baer et al., 1999; Helman, 1978; Nichter & Nichter, 1994; Sigelman, Maddock, Epstein, & Carpenter, 1993). Adults nag children to put on a raincoat, carry an umbrella, dry themselves quickly after swimming, and wear a jacket when it is windy or when they go into an air-conditioned room. Where do such beliefs come from? People may indeed be more likely to catch a cold or the flu when the weather is cool and damp than when it is warm and dry. But the weather probably does not make them sick directly. The weather may simply provide a good environment for the viruses that do make them sick. Many strains of cold/flu viruses survive longer in cool, moist air than in warm dry air (e.g., Bean et al., 1982; Elazhary & Derbyshire, 1979; Karim, Ijaz, Sattar, & Johnson-Lussenburg, 1985; Reagan, McGeady, & Crowell, 1981). The longer a virus survives—on a towel, a door knob, etc.—the more chances it has to infect someone. It is no wonder that, across cultures, people have come to associate catching a cold or the flu with exposure to cold air.

It is an easy next step to decide that exposure to cold air causes the infection. In everyday life, we almost always infer causal relations from correlations because: (1) we generally do not have first-hand information about underlying causal mechanisms, which are typically not readily perceptible; and (2) we generally do not have experimental data to uncover causal relations and have to make do with observable correlations. Using correlational data to speculate about causes can actually be quite fruitful. It has led to major scientific discoveries such as the bacteria that cause stomach ulcers (e.g., Thagard, 2000). Believing that exposure to chilly air causes colds and flu can be useful if the belief translates into greater vigilance about colds and flu. Such vigilance can join forces with health tips for cold/flu prevention (e.g., wash hands frequently) to increase health-promoting behaviors. Potential benefits like this, along with the compelling correlation between chilly season and cold/flu season, may in part