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Cognitive constraints influence an understanding of life-cycle change

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ABSTRACT

We investigated children's (n = 120; 3- to 11-year-olds) and adults' (n = 18) reasoning about life-cycle changes in biological organisms by examining their endorsements of four different patterns of life-span changes. Participants were presented with two separate tasks: (a) judging possible adult versions of a juvenile animal and (b) judging possible juvenile versions of an adult animal. The stimuli enabled us to examine the endorsement of four different patterns of change: identical growth, natural growth, dramatic change, and speciation. The results suggest that endorsement of the different patterns is influenced by age and familiarity. Young children and individuals confronted with unfamiliar organisms often endorsed an identical growth that emphasizes the stability of features over the life span and between parents and offspring. The results are interpreted as supporting the idea that cognitive constraints influence individuals' reasoning about biological change and that the influence of these constraints is most notable when individuals are young or are presented with unfamiliar biological organisms.

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Introduction

A basic component of a folk biology is an understanding of what types of change occur naturally over the course of an organism's life span. At its core, this understanding focuses on the concept of growth—that animals over the course of their lives get larger and change in predictable ways (Rosengren, Gelman, Kalish, & McCormick, 1991). However, some patterns of life-cycle changes can be quite dramatic, involving drastic changes in appearance and behavior such as when a caterpillar undergoes metamorphosis, becoming a butterfly. Examining how individuals reason about different patterns of life-cycle changes can provide insight into the development of intuitive reasoning concepts about the biological world and the extent to which such reasoning is influenced by underlying cognitive constraints. The main goal of the current study was to investigate how individuals reason about life-cycle changes and how judgments about the possibility of life-cycle change are influenced by age and familiarity with the biological organism.

Researchers have investigated several cognitive constraints that might influence reasoning about the natural world (e.g., anthropocentric and teleological reasoning; Arenson & Coley, 2018; Kelemen, 2012), and many have explored children's and adults' reasoning about biological organisms in terms of a particular constraint—psychological essentialism (Emmons & Kelemen, 2015; Gelman, 2003; Gelman & Rhodes, 2012; Shtulman & Schulz, 2008). Psychological essentialism refers to the notion that people act as if they hold an implicit belief that category membership is determined by an underlying essence (Medin & Ortony, 1989).

Gelman and colleagues (Gelman, 2003; Gelman & Rhodes, 2012) have proposed that essentialism is composed of a number of components, including immutability (i.e., that an organism's biological category membership is stable over physical transformations), innate potential (i.e., that the developmental trajectory of an organism is fixed at birth), intensification of category boundaries (i.e., that category membership is binary), nonobvious causal properties (i.e., that unobservable properties are responsible for surface appearances), and inductive potential (i.e., that knowledge of category membership enables the generalization of inferences). These components are thought to structure the ways in which individuals think about the category membership of natural kinds (but see Bloom, 1999; Diesendruck, Markson, & Bloom, 2003). We argue that these components operate as different essentialistic constraints on reasoning at different levels of abstraction (Evans & Rosengren, 2018). Few, if any, studies have investigated how these components explicitly influence biological reasoning about biological change and whether the individual components have different developmental trajectories. Thus, a further goal of this study was to chart their probable developmental course by linking components of essentialism to different patterns of biological change.

Patterns of biological change: Identical growth, naturalistic growth, dramatic change, and species change

In previous research investigating children's beliefs about four different patterns of biological change, Rosengren et al. (1991) used a forced-choice task to examine whether children understood that animals grow bigger over the life span (see also Inagaki & Hatano, 1996). Young children (3- and 4-year-olds) consistently responded that animals could get bigger over the life span but generally did not accept that animals would change in other ways (e.g., change in color, undergo metamorphosis). We refer to this pattern of change as identical growth because the only feature that changes over the life span is physical size; on all other physical dimensions, the juvenile and adult versions are expected to be the same. This pattern of growth does not normally occur; organisms change in proportion as well as in size. The current study extends this work by using highly realistic drawings rather than simple line drawings, using a larger stimuli set to more closely examine patterns of reasoning, and examining the impact of familiarity on both children's and adults' reasoning about biological change.

The second pattern of change, which we refer to as naturalistic growth, involves changes in size and changes in physical proportions. This is the pattern of change that distinguishes juvenile and adult features (i.e., juveniles have softer smaller features and proportional differences). Lorenz (1971) argued that these features help infants of different species to survive because they generally elicit affection,