

**CHILDREN'S AND ADULTS' UNDERSTANDING OF THE
PERSISTENCE OF INDIVIDUAL ARTIFACTS**

by

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Abstract

Artifacts are ubiquitous in our lives, and we routinely face the task of tracking them through spatiotemporal and qualitative change. How people reason about the identity of individual artifacts through such changes is not well understood. This dissertation reports nine studies that sought to illuminate human reasoning about individual artifact persistence.

Studies 1 to 4 examined whether people's attributions of individual persistence to artifacts depend on the maintenance of the objects' kind. Neither children nor adults systematically judged artifacts to be the same individuals following kind-altering transformations. In contrast, 7-year-olds and adults, but not 5-year-olds, judged animals to be the same individuals following such changes. The findings reveal increasing domain specificity in the importance of maintained kind membership for attributions of individual persistence to artifacts.

Studies 5 to 8 explored whether the linguistic expression used to label an artifact affects people's judgments of persistence. Participants learned about scenarios involving a complete part-by-part transformation of an artifact, followed by the reassembly of the original parts to create a second artifact. When the pre-transformation artifact was labeled with a *proper name*, 5- to 7-year-olds and adults extended the expression to only *one* post-transformation object, indicating a belief that names pick out artifacts as unique individuals. When the same artifact was labeled with a *description*, however, people extended the expression to *as many* objects as matched the description, suggesting a belief that descriptions pick out artifacts in a different manner – namely, as instances of a kind with particular properties.

Study 9 assessed whether an artifact's history (being owned by a celebrity or a non-celebrity) influences adults' reasoning about its persistence. Participants read scenarios involving the type of transformation presented in Studies 5 to 8. We found that an artifact's history increased adults' ascriptions of its *persisting worth*, but it did not influence judgments of its *persisting identity*.

By explicating how people reason about individual artifact persistence, these studies advance our understanding of several broad issues about human cognition, including the nature of our concepts, the influence of language on cognition, and the effects of social factors (i.e., an artifact's history) on conceptual representation.

Preface

The research presented in this dissertation is the work of the author and was developed through discussion and collaboration with her advisor, Dr. D. Geoffrey Hall. The author had primary responsibility for all aspects of all the research. The data collection and analysis for Studies 1 – 4, however, was conducted in collaboration with Kyle Dadgar (undergraduate honours student).

A version of Chapter 4 is currently in press (reference: Marchak, K. A., & Hall, D. G. (in press). Transforming Celebrity Objects: Implications for an Account of Psychological Contagion. *Journal of Cognition and Culture*.)

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1 Introduction

1.1 General Introduction

Artifacts (e.g., balls, chairs, cars, ships) are ubiquitous in our lives: We encounter and interact with thousands of them every day, and we routinely face the task of tracking them as the same individuals through spatiotemporal and qualitative change. This task arises for several reasons, perhaps the most salient of which is that artifacts are often the property of individuals (e.g., my cellphone, your car, Warren's boat) with interests in maintaining ownership. Our daily lives and social environments would be chaotic if we could not track particular artifacts through displacement and change. This fundamental cognitive capacity is not well understood as it pertains to physical objects in any conceptual domain, but it is especially poorly understood in the domain of artifacts. How do children and adults determine whether an artifact seen now is the same individual as one observed at an earlier time (e.g., how do they judge whether a table seen now is *the same* table as one previously seen)? Are children's and adults' judgments of persistence influenced by the way that we speak about an artifact? Does the history of an artifact influence how people reason about its persistence over time? This dissertation will address these and related questions about how people reason about individual artifact persistence through change.

To begin it is important to note that reasoning about artifacts differs from reasoning about other kinds of things in the world. An artifact by its very definition is "an object made or modified by human workmanship, as opposed to one formed by natural processes" (Oxford English Dictionary). This characterization makes reference to the

basic ontological distinction between nominal kinds (including artifacts), which are categories that are created by humans, and natural kinds (e.g., animals, plants, minerals), which are categories that exist in nature (Putnam, 1975; Schwartz, 1977, 1980)¹. This distinction is important because researchers have documented a fundamental difference in the beliefs that people hold about members of natural and nominal kinds. Extensive evidence has led many researchers to posit that people think that members of natural kinds (i.e., animals) possess an essence (i.e., a causal property that is responsible for the object's surface features) that is deep (e.g., DNA or some other internal property), whereas they think that members of nominal kinds (i.e., artifacts) possess an essence that is more shallow (i.e., the creator's intended function; see Gelman, 2003, for a review; see also, Brandone & Gelman, 2013; Gelman & Markman, 1986; Keil, 1989, Kelemen & Carey, 2007). One line of this evidence is particularly relevant to the topic of this dissertation. For example, Keil (1989) found that young school-aged children and adults judged an animal's kind to remain constant following transformations to its surface appearance, whereas they judged an artifact's kind to be altered following the same changes. This domain difference in judgments about retained kind membership in the wake of change suggests a basic distinction in how children and adults represent artifact and animal kinds. The research in this dissertation will therefore examine children's and adults' concepts of artifacts against the backdrop of their concepts of animals, in an effort to uncover what is unique about the way that they represent and reason about artifacts.

¹ In the literature, however, it has been noted that the distinction between nominal and natural kinds is not categorical (see Bloom, 2007; Grandy, 2007, for discussion). In particular, there appear to be boundary cases, such as domestic dogs and seedless grapes, which could be considered examples of either natural kinds (because they exist in nature) or nominal kinds (because they require human intervention—i.e., selective breeding—to exist).

1.2 The Representation of Artifacts

Given the prevalence of artifacts in our world, there has been considerable interest in understanding how children and adults represent and reason about these objects in the fields of philosophy (see Margolis & Laurence, 2007; Putnam, 1975) and psychology (e.g., Bloom, 1996; Gelman, 1988; Keil, 1989; Malt & Johnson, 1992). Most of the psychological literature about artifacts, however, has focused on how children and adults reason about these objects as *kind members* (e.g., balls, chairs, cars, ships) rather than as *individuals* (e.g., one particular ball, one specific chair, one unique car, one singular ship). The following discussion begins with a review of the extensive research on the criteria that guide people's representations of artifact kinds and how reliance on these criteria changes over the course of development. It will be followed by a discussion of the more limited research on the criteria that guide people's representations of individual artifacts and how dependence on these criteria changes in development.

1.2.1 Artifact Kinds

There is a large body of literature focused on how people reason about artifacts as *kind members*. This research has extensively explored the criteria that people use to determine whether an object is a member of a particular artifact kind. Most of these studies have examined the importance of two criteria in judgments of an artifact's kind membership — its *shape/form* and its *current function* (see Malt & Sloman, 2007, for a review). In the first study on this topic, Gentner (1978) examined the relative importance of these criteria for children of different ages by presenting participants with two novel artifacts that differed in both their shape/form and their function. She then taught participants a distinct count noun (a label for the object's kind) for each of the artifacts

(e.g., "This is a JIGGY and this is a ZIMBO"). Afterward, she presented participants with a hybrid of the two artifacts (i.e., an artifact that had the same shape/form as the first novel object, but performed the function of the second novel object) and asked participants which of the count nouns they would use for the object (e.g., "Is this a JIGGY or is this a ZIMBO?"). Two-year-olds tended to select the label of the object with the same shape/form, suggesting that they relied on an artifact's shape/form for judgments of its kind membership, whereas 5-year-olds tended to select the label of the artifact with the same function, suggesting that they relied on the object's current function.

Gentner's (1978) study was the first in a long line of research on the criteria that guide attributions of artifact kind membership (see Malt & Sloman, 2007, for a review; see also Diesendruck, Hammer, & Catz, 2003; Graham & Diesendruck, 2010; Graham, Williams, & Huber, 1999; Gutheil, Bloom, Valderrama, & Freedman, 2004; Keil, 1989; Kemler Nelson, 1995; Kemler Nelson, Russell, Duke, & Jones, 2000; Landau, Smith, & Jones, 1988, 1992, 1998; Markson, Diesendruck, & Bloom, 2008; Smith, Jones, & Landau, 1996; Smith, Jones, Landau, Gershkoff-Stowe, & Samuelson, 2002). While the exact nature of the task influences the extent to which people rely on either of these criteria, the general pattern observed in this work is that younger children's attributions of artifact kind membership depend on shape/form, whereas older children's and adults' attributions depend on current function.

Other researchers, however, have argued that people rely on an artifact's shape/form or current function to determine its kind *only* because these cues provide an indication of the *creator's intended function* (Defeyter & German, 2003; Dennett, 1987, 1990; Diesendruck, Markson, & Bloom, 2003; Gelman & Bloom, 2000; German &

Johnson, 2002; Kelemen, Seston, & Saint Georges, 2012; Kemler Nelson, Herron, & Morris, 2002; Matan & Carey, 2001)². According to these researchers, the core criterion that people use to judge whether an object belongs to an artifact kind (e.g., is a mug) is the original intended function of the creator (e.g., to contain liquids) (see Kelemen & Carey, 2007, for a review). These researchers have based their claims on the results of experiments that involve presenting participants with an artifact that was designed for a certain purpose (e.g., to make tea), but that someone is currently using for a different purpose (e.g., to water flowers) (see Matan & Carey, 2001). When asked about the object's kind membership, 4-year-olds relied on the current function of the object (e.g., judging that it was a watering can), whereas 6-year-olds (and adults) relied on the original function of the object (e.g., judging that it was a teapot).

In summary, the research on people's representations of artifacts as instances of kinds reveals that, early in development, children rely on an artifact's surface features, such as its shape/form, to determine its kind membership. It is not until the early school years, however, that children develop a richer understanding of artifact kinds and rely on the creator's intended function as the core criterion to determine kind membership. With respect to the earlier discussion about the essences of kinds, it thus appears that people come to understand the creator's intended function to be the essence of an artifact kind (see Kelemen & Carey, 2007; Matan & Carey, 2001). Unlike the essence of an animal kind, however, the essence of an artifact kind is shallow in nature. In particular, it is relatively easy to discover the essence of an artifact's kind. For instance, you can easily

² See Bloom (1996) for a more extreme version of this proposal. According to his view, the main criterion that people use to judge whether an object belongs to a particular artifact kind (e.g., is a mug) is whether the person who created the object intended it to belong to that kind (e.g., to be a mug) and not what the creator intended the object's function to be (e.g., to contain liquids).

learn the creator's intended function for an artifact (e.g., whether he/she intended it to contain liquids). In contrast, it is more difficult (if not impossible) to discover the essence of an animal's kind. For instance, it would require scientific study (in fields such as biology or zoology) to uncover the essence of an animal kind (e.g., its DNA or some other internal property). Furthermore, the nature of an artifact's essence (i.e., the creator's intended function) may explain why Keil (1989) found that young children and adults judged an artifact's, but not animal's, kind to be altered following transformations to the object's appearance. It seems plausible that people responded in this way because they inferred that when an artifact's shape/form was modified the transformation also altered the creator's intended function, and thus the object's kind membership.

1.2.2 Individual Artifacts

While it is important to understand how people represent and reason about artifacts as instances of kinds, it is also important to understand how they represent and reason about individual artifacts. Although we often fail to treat singular artifacts as important in their own right (e.g., we may judge one fork to be just as good as any other fork to eat with), there are *many* situations in which we construe artifacts as having a unique individual identity. For instance, artifacts can acquire a special importance in a number of ways, including through a connection to a particular person (e.g., my laptop computer, Jacqueline Onassis' sunglasses), a historic event (e.g., a chair from the Titanic wreckage), or ancient times (e.g., a pot from ancient Greece) (Frazier & Gelman, 2009; Frazier, Gelman, Wilson, & Hood, 2009; Gelman, Frazier, Noles, Manczak, & Stilwell, 2015; Gelman, Manczak, Was, & Noles, 2016; Hood & Bloom, 2008). In Chapter 4 of

this dissertation, we will explore whether the way that people reason about an artifact depends on its history.

Reasoning about individual artifacts is a complex feat, however, because people need to be able to track the same object over time and through change. When we consider children's and adults' worlds, it is important for them not only to be able to *identify* an artifact at one point in time, but also to *re-identify* the same artifact at later points in time. Researchers have argued that the ability to re-identify a specific artifact is particularly important because people have the right to use the objects that belong to them (e.g., their cellphones or their cars), but not identical-looking ones owned by others (Neary & Friedman, 2014; Snare, 1972). Previous research has shown that from early in development, children track particular artifacts (e.g., toys, blankets) that belong to them, even when other identical-looking objects are present (Gelman, Manczak, & Noles, 2012; Gelman, Noles, & Stilwell, 2014; Hood & Bloom, 2008; McEwan, Pesowski, & Friedman, 2016; Nancekivell & Friedman, 2014; Ross, Friedman, & Field, 2015). Furthermore, children and adults also need to be able to track individual artifacts following change. This capacity is necessary because these objects commonly undergo externally caused transformations, including some that are superficial (e.g., becoming dented) and others that are more extreme (e.g., experiencing part replacement and disassembly/reassembly). In this dissertation, we will focus on transformations that involve more severe changes – specifically, situations in which artifacts experience changes to (1) their constituent parts over time as they undergo alteration (e.g., suits), repair (e.g., cars), upgrading (e.g., computers) or restoration (e.g., tables) and (2) their continuity as a whole when they are taken apart and later put back together for ease of

transport (e.g., bicycles), cleaning (e.g., pipes) or storage (e.g., tents). We are interested in these transformations, because (as we will explain) they provide a particularly powerful way to acquire insight into people's concepts of individual artifacts.

Philosophers have long noted the importance of understanding how people reason about the individual persistence of an artifact following such changes (Grandy, 2007; Hirsch, 1982, Hobbes, 1672 /1913; Hume, 1739/2000; Wiggins, 2001). The enduring discussion in the philosophical literature has centered on three criteria that people may use to determine whether an artifact stays the same persisting individual over time and following transformation. The first criterion that has been proposed to guide attributions of individual persistence is an object's *appearance* (e.g., its shape/form). If two artifacts are sufficiently perceptually similar, we may often judge them to be the same individual. Although it seems likely that we use similarity to make initial judgments of individual persistence, there are two facts that refute the possibility that similarity alone underlies these decisions. First, a high degree of similarity between two objects is not sufficient to guarantee attributions of persistence. There are clear cases (e.g., mass-produced artifacts) in which we would not confidently attribute the same individual identity to two indistinguishable objects seen at different times. Second, a high degree of similarity between two objects may not even be necessary for judgments of individual persistence. There are situations in which we may ascribe a persisting individual identity to objects that undergo dramatic perceptual changes over time (e.g., artifacts that are transformed by a person from one kind of thing to another). These considerations suggest that another criterion or criteria must underlie judgments of individual persistence.

A second criterion that philosophers have proposed to guide attributions of individual persistence is *continuity* (see Scholl, 2007, for a review; see also, Bloom, 2000; Rips, Blok, & Newman, 2006). In other words, people may require an object to trace some sort of connected path in order to infer that it remains the same individual. There is evidence from early infancy that judgments of individual persistence are based on this criterion (e.g., Bloom, 2000; Spelke, 1990, 2000; Spelke, Kestenbaum, Simons, & Wein, 1995). Yet continuity may apply to an object at different levels of analysis: There may be spatio-temporal continuity of the object *as a whole* and/or spatio-temporal continuity of the object's *parts/material*. Note that these levels of continuity are related in most situations: An object that follows a spatio-temporally continuous path as a whole is also likely to be made of the same spatio-temporally continuous parts/material, if the artifact does not undergo change. As previously discussed, artifacts *do* commonly undergo transformations that involve disruptions to the spatio-temporal continuity of the object *as a whole* (i.e., disassembly) and/or to the spatio-temporal continuity of its *parts/material* (i.e., part replacement).

In one of the only studies to examine how children and adults reason about the persistence of individual artifacts following change, Hall (1998) explored the relative importance of an object's spatio-temporal continuity *as a whole* and the spatio-temporal continuity of its *parts/material* in people's attributions of individual persistence. To examine this question, Hall presented adults, 5-, and 7-year-olds with a novel object (labeled with a count noun, "QUIGGLE") that was (1) owned by a particular character (i.e., Sam) and (2) described as either an artifact or an animal. Participants were then shown pictures of the object undergoing a transformation that involved the complete

replacement of its parts, followed by the subsequent reassembly of the original parts/material. The event, thus, resulted in two objects: one that followed a spatio-temporally connected path as a whole, but that was made entirely of new parts/material (*new-parts* object), and another that did *not* follow a spatio-temporally connected path as a whole, but that was made of the original spatio-temporally connected parts/material (*old-parts* object). Children and adults were then asked which of the post-transformation objects was the same *individual* artifact (i.e., "Where is Sam's QUIGGLE?"). It is interesting to note that the question posed to participants was framed using a noun phrase (i.e., "Sam's QUIGGLE"), which picks out an object as a particular instance of the kind (i.e., a QUIGGLE owned by Sam), and not as an individual (i.e., as "X", a proper name). In Chapter 3 of this dissertation, we will explore whether intuitions about an artifact's persistence following such transformations depend on the expression (noun phrase or proper name) used to label the object.

In Hall (1998)'s study, when children and adults judged the individual persistence of an artifact following an externally caused transformation (i.e., human-caused disassembly and subsequent reassembly), they tended to select the *old-parts* object. Their attributions of persistence thus relied on the spatio-temporal continuity of the object's *parts/material*, rather than on the spatio-temporal continuity of the object *as a whole*. Yet when children and adults were asked to judge the individual persistence of an animal following a spontaneous transformation (i.e., growth and regeneration), adults and 7-year-olds (but not 5-year-olds) tended to select the *new-parts* object, showing a reliance on an animal's spatio-temporal continuity *as a whole* for ascriptions of its individual

persistence. The data show that the criteria that guide attributions of individual persistence depend on the ontological status of the object.

Finally, philosophers have proposed a third criterion that may also be necessary for attributions of individual persistence – an object's maintained *sortal category membership* (Hirsch, 1982; Macnamara, 1986; Wiggins, 2001; Xu, 2007). In other words, for people to judge an object (e.g., a car) to be the same persisting individual (e.g., "Batmobile") philosophers have suggested that it may need to remain the *same kind of thing* (i.e., stay a car). There has been extensive debate in the literature about the importance of this criterion for attributions of individual persistence (see Blok, Newman, & Rips, 2007a, 2007b; Rhemtulla & Xu, 2007a, 2007b; Rips et al., 2006; Xu, 2007). Prior studies that have examined this criterion have shown that ascriptions of individual persistence do not depend on an object's maintained sortal category membership (Blok, Newman, & Rips, 2005; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006). These studies have had a limited focus, however, which raises questions about the generality of this evidence. In Chapter 2 of this dissertation, we will systematically explore the role of an artifact's maintained sortal category membership on judgments of its individual persistence.

In summary, in the philosophical literature, three criteria have been proposed to be important for people's attributions of individual persistence to artifacts. The limited studies that exist show that, from early in development, children and adults rely on an artifact's spatio-temporal continuity (especially that of its parts/material) for ascriptions of its individual persistence (Hall, 1998). Yet there is the need for additional research to

examine whether other criteria (in particular, the persistence of an artifact's sortal category membership) also influence these attributions.

1.3 Thesis Rationale

Given the prevalence of artifacts in our world, children and adults are often faced with situations in which they need to re-identify the same individual artifact over time and following change. Philosophers have long realized the importance of understanding how people reason about whether an artifact observed at one time is the *same* as an artifact observed at a later time (see Scholl, 2007, for a review). Yet, the experimental examination of these same topics has been sparse (see Blok et al., 2005; Hall, 1998; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006, for exceptions). The research in this dissertation contributes to the psychological literature on children's and adults' representations of individual artifacts by examining three issues of particular importance to how people reason about the persistence of these objects. First, in Chapter 2 (Studies 1 – 4), we explored the nature of children's and adults' concepts of individual artifacts by focusing on the criteria that people use to reason about an object's persistence through change. Second, in Chapter 3 (Studies 5 – 8), we assessed whether the expression that we use to label an artifact influences how children and adults reason about persistence. Third, in Chapter 4 (Study 9), we examined whether the history of an artifact, such as its being owned by a famous person, influences how adults reason about its persistence (both its *worth* and its individual *identity*) following change.

1.3.1 Criteria that Guide Attributions of Individual Persistence

In Chapter 2 of this dissertation, we examined a central question about the nature of people's concepts of individual artifacts by exploring the criteria that guide people's representations of these objects. In particular, we assessed whether these attributions depend on the persistence of the objects' kind membership through change. As previously mentioned, there has been debate in the literature about whether an object's kind (i.e., *sortal*) persistence is necessary for attributions of individual persistence (see Blok et al., 2007a, 2007b; Rhemtulla & Xu, 2007a, 2007b; Rips et al., 2006; Xu, 2007). The *sortalist* account posits that attributions of individual persistence depend on an object's remaining the same kind of thing (i.e., a member of the same sortal category) through change (Hirsch, 1982; Macnamara, 1986; Wiggins, 2001; Xu, 2007). In contrast, *continuity* accounts stress that a persisting individual need not remain the same kind of thing, provided it demonstrates some form of connectedness (e.g., spatio-temporal, causal) (e.g., Bloom, 2000; Rips et al., 2006).

Previous research (Blok et al., 2005; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006) has found that people often judge an object to persist as the same individual, even when they no longer judge it to be a member of the same kind. These results suggest that maintenance of an object's kind is not a necessary criterion for people's attributions of individual persistence, in line with continuity accounts. While prior studies have uncovered evidence that ascriptions of individual persistence do not depend on maintained sortal category membership, their limited focus (i.e., on transformations based on science fiction or the supernatural) raises questions about the generality of this evidence. Specifically, previous work has not systematically

examined the effect of several factors that we expect to influence people's attributions of individual persistence through kind-altering transformation, in particular (1) the object's kind domain, (2) the cause of the transformation, (3) the consistency of the label(s) used to speak about the object, and (4) the participants' age. In Studies 1 to 4, we examined whether these factors influence children's and adults' attributions of individual persistence for artifacts (and animals, as a point of comparison) following kind-altering transformations.

The results of these studies serve to illuminate the criteria that people use to determine whether they are encountering the same individual artifact (or animal) as one they have previously seen. In particular, the studies offer new insight into the role of sortals in our concepts of individuals (Hirsch, 1982; Macnamara, 1986; Wiggins, 2001; Xu, 2007). In this way, the data provide a fresh perspective on a core cognitive capacity — how people track particular objects over time. Additionally, this work sheds light on the acquisition of our concepts of individual artifacts. Specifically, it is the first comprehensive examination of whether there is a developmental change in the way in which adults and children reason about an artifact's individual persistence following kind-altering transformations.

1.3.2 The Role of Labels in Attributions of Persistence

When we encounter an artifact (e.g., a car owned by Batman), there are many ways that we can label it: We could *name* it using a proper name (e.g., "Batmobile") or we could *describe* it using a noun phrase (e.g. "Batman's car"). Either type of expression may unambiguously refer to an artifact at a particular time, raising the question of whether there are any cognitive implications of choosing one expression over the other.

Many philosophers have argued that there is a clear distinction between the meaning of names and descriptions (Mill, 1843/1941; see also, Donnellan, 1966, 1972; Kripke, 1980): Proper names allow us to (re)-identify an individual, whereas descriptions allow us to (re)-identify any object/objects that has/have the same property/properties. While the distinction between proper names and descriptions has been extensively discussed in the philosophical literature, there has been limited psychological research that has examined this difference (see Hall, Waxman, Brédart, & Nicolay, 2003, for an exception).

In Chapter 3 (Studies 5 – 8), we examined whether the linguistic expression (either a proper name or a description) that we use to label an artifact influences how people reason about persistence following change. In this way, our studies investigated whether there is an unexplored link between language and cognition. This research addresses the longstanding debate in the philosophical literature about the relationship between names and descriptions (cf. Frege, 1892; Russell, 1905 and Mill, 1843/1941; see also, Donnellan, 1966, 1972; Kripke, 1980). In addition, these studies provide new insight into philosophers' enduring discussion about the criteria that underlie the persistence of artifacts (Hirsch, 1982, Hobbes, 1672 /1913; Hume, 1739/2000; Wiggins, 2001), showing that it is possible to acquire empirical answers to some of philosophy's most thorny questions.

1.3.3 The Role of History in Attributions of Persistence

As previously mentioned, individual artifacts can acquire an important history in a number of ways including through a connection to a celebrity (e.g., John Lennon's piano, John F. Kennedy's desk). There is a large body of research that shows that people ascribe

an enhanced worth to artifacts owned by famous individuals (Frazier & Gelman, 2009; Frazier et al., 2009; Gelman et al., 2015; Gjerseoe, Newman, Chituc, & Hood, 2014; Hood & Bloom, 2008; Newman & Bloom, 2014; Newman, Diesendruck, & Bloom, 2011; Newman & Smith, 2016). This "celebrity effect" has been attributed to a belief in psychological contagion, the transmission of a person's essence to an object via contact (Gelman et al., 2015; Newman & Bloom, 2014; Newman et al., 2011; Rozin & Nemeroff, 1990). Although the existence of the celebrity effect has been widely documented, relatively little is known about the nature of this phenomenon, or about the nature of the psychological contagion posited to underlie it. In particular, it is unclear whether the effect persists in artifacts following any of the transformations they routinely undergo.

To explore this issue, in Chapter 4 (Study 9), we examined adults' judgments of (1) the persisting identity and (2) the persisting worth of celebrity-owned artifacts following transformations to their parts/material. We explored whether an artifact's history (i.e., its being owned by a celebrity) influences how adults reason about its individual persistence. Philosophers have debated whether the criteria used to ascribe individual persistence to an artifact depend on its history (Dauer, 1972; Smart 1972,1973). This study provided empirical data relevant to this debate by comparing attributions of individual persistence for celebrity and non-celebrity artifacts following transformations.

Additionally, we addressed how the enhanced worth ascribed to celebrity objects persists in artifacts following change. The results of the study offer fresh insight into the nature of psychological contagion. In particular, they shed light on whether adults reason about the essence that is transmitted in psychological contagion as akin to a residue

deposited in/on the object rather than a germ capable of spreading in an indirect manner to new parts/material added to the object (see Nemeroff & Rozin, 1994, on germ vs. residue models of psychological contagion).

Together the nine experiments in this dissertation make a significant new contribution to the literature on how children and adults represent and reason about individual artifacts. In particular, the studies offer fresh insight into a number of deep and longstanding questions about the human mind, pertaining to the nature of our concepts and their acquisition, the influence of language on cognition, and the effects of social factors (i.e., an object's history) on conceptual representation.

2 Criteria that Guide Attributions of Persistence

2.1 Introduction

In our daily lives, we encounter countless artifacts (e.g., tables, cars, chairs). These encounters present us with two fundamental types of problems. One is to identify what kind of thing the artifact is at the time we see it (e.g., to judge whether the object that we see now is *a table*). Another is to identify whether an artifact seen now is the same individual as one seen at an earlier time (e.g., to judge whether something seen now is *the same* table as one previously seen). A great deal of research has focused on how people determine whether an artifact belongs to a particular kind (see Malt & Sloman, 2007; Murphy, 2002, for reviews). Less work, however, has focused on how people determine whether an object remains the same individual over time (Blok et al., 2005; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006). The problem of identifying an individual artifact over time is complicated by the fact that these objects often experience changes. Some of these changes preserve the object's kind (e.g., when someone takes a table apart for ease of storage or transport and later puts it back together), while others alter the object's kind (e.g., when someone takes a table apart and later constructs a chair from the parts). In the current studies, we addressed the fundamental question of what criteria adults and children use to attribute individual persistence to artifacts following such changes. Our primary interest was in the criteria that guide attributions for artifacts; however, we included animals in our study as a point of comparison to uncover what is unique about the way that children and adults reason about artifacts.

One possibility is that people's attributions of individual persistence are based simply on the perceived similarity between an object observed at time 1 and an object observed at time 2. If the two objects are sufficiently similar, we may judge them to be the same individual (for discussion, see Rips et al., 2006). Although it seems likely that we often use similarity to make initial judgments of individual persistence, similarity alone cannot underlie these decisions. A high degree of similarity between two objects is not sufficient to guarantee attributions of persistence: There are cases (e.g., mass-produced artifacts, identical twins) in which we would not confidently attribute the same individual identity to two indistinguishable objects seen at different times. A high degree of similarity between two objects may not even be necessary for judgments of individual persistence. As we will explore in these studies, we may ascribe a persisting individual identity to objects that undergo dramatic perceptual changes over time (e.g., artifacts that are transformed by a person from one kind of thing to another or animals that undergo metamorphosis). These considerations suggest that another criterion or criteria must underlie judgments of individual persistence. In the literature on people's attributions of persistence to individual objects, two criteria have been the subject of recent discussion (Blok et al., 2007a, 2007b; Rhemtulla & Xu, 2007a, 2007b).

First, there is agreement in the literature that inferred *continuity* is a necessary criterion for attributions of individual persistence to an object (see Bloom, 2000; Rips et al., 2006; Xu, 2007). People must believe that an object traces some sort of connected path in order to infer that it remains the same individual. The nature of this continuity has been the focus of debate. From early infancy, there is evidence that judgments of individual persistence are based on *spatio-temporal* continuity (e.g., Bloom, 2000;

Spelke, 1990, 2000; Spelke et al., 1995). More recently, however, Blok et al. (2005; Rips et al., 2006) have argued that attributions of persistence derive from a more abstract inference of *causal* continuity. Even in the absence of a spatio-temporal connection, Rips et al. (2006) have presented evidence that people will judge an object to persist if they infer that there is a causal link between an object observed at time 1 and an object observed at time 2.

Although there is agreement that continuity is necessary for judgments of individual persistence, debate in the literature centers on whether it is also sufficient, with researchers divided in their assessment of whether a second criterion must also be satisfied. According to the *sortalist* account, attributions of individual persistence depend additionally on the inference that an object remains the *same kind of thing* (i.e., remains a member of the same *sortal category*) (Hirsch, 1982; Macnamara, 1986; Wiggins, 2001; Xu, 2007). On this account, people judge a continuous object (e.g., a dog) to be the same persisting individual (e.g., Fido) only if it additionally remains the same kind of thing (i.e., stays a dog). In contrast, simple *continuity* accounts stress that a persisting individual need not remain the same kind of thing, provided it demonstrates some form of connectedness that is either spatio-temporal (e.g., Bloom, 2000; Gutheil, Gelman, Klein, Michos, & Kelaita, 2008; Spelke, 1990, 2000; Spelke et al., 1995) or causal (Blok et al., 2005; Rips et al., 2006). From this perspective, people judge a continuous object (e.g., a dog) to be the same persisting individual (e.g., Fido) even if it ceases to be the same kind of a thing (i.e., stops being a dog).

Previous research has attempted to test between sortalist and continuity accounts by examining people's attributions of individual persistence to objects that experience

continuous kind-preserving and kind-altering transformations (Blok et al., 2005; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006). For example, Rhemtulla and Hall (2009) presented adults with an object (e.g., a duck named "V74") that was described as undergoing a continuous transformation (e.g., being taken apart and reconstituted in an "atom reassembler") that resulted in either an object of the same kind (e.g., a duck) or an object of a different kind (e.g., a helmet). Following the transformation, participants were asked to judge whether the object persisted as an instance of the kind (e.g., "Is this still a duck?") and as the same individual (e.g., "Is this still V74?"). The results of Rhemtulla and Hall (and other prior studies; Blok et al., 2005; Leonard & Rips, 2015; Rips et al., 2006) have revealed a dissociation between adults' judgments of individual and kind persistence: Adults judged an object to persist as the same individual (e.g., "V74"), even when they judged it to no longer be a member of the same kind (e.g., a duck). These results suggest that maintenance of an object's kind is not a necessary criterion for adults' attributions of individual persistence, in line with continuity accounts.

While prior studies have uncovered evidence that ascriptions of individual persistence do not depend on maintained sortal category membership, their limited focus raises questions about the generality of this evidence. Specifically, previous work has not systematically examined the effect of several factors that we hypothesize to influence people's attributions of individual persistence following kind-altering transformations: in particular, these factors are (1) the object's kind domain, (2) the cause of the transformation, (3) the consistency of the label(s) used to speak about the object, and (4) the participants' age.

1) **Object's kind domain.** Previous research has not explored whether people reason in different ways about the individual persistence of artifacts and animals, despite the fact that there is a large literature indicating that people represent objects from these domains in different ways (see Gelman, 2003, for a review). In a seminal study, Keil (1989), examined domain differences in children's attributions of *kind persistence* (e.g., "Is this a RACOON?") to objects following transformations. Five-, 7-, and 9-year-olds judged an artifact's kind to be changed when its surface features were altered (e.g., when a coffeepot was made to look like a birdfeeder, children judged that it was *no longer* a coffeepot). In contrast, there was a change across development in how children reasoned about an animal's kind persistence: Seven- and 9-year-olds (but not 5-year-olds) judged an animal's kind to persist when its surface features were altered (e.g., when a raccoon was made to look like a skunk, older children judged that it was *still* a raccoon).

Keil (1989)'s data raise the possibility that people believe that members of kinds from different domains possess different types of essences (i.e., causal properties that are responsible for the object's surface features). In particular, the findings have led some researchers to suggest that people come to believe that members of animal kinds possess a deep essence (e.g., DNA or some other hidden property), whereas they believe that members of artifact kinds possess a shallow essence (e.g., the creator's intended function; see Gelman, 2003, for a review of other evidence on essentialism; see also, Kelemen & Carey, 2007). Consequently, some researchers have proposed that people may expect an animal's essence, but not an artifact's essence, to provide a principle of individual persistence through change (see Gelman, 2003). Keil's study, however, leaves open the question of whether judgments of *individual* persistence through change (e.g., "Is this

ROCKY?") also depend on the kind domain of the object undergoing the transformation. To address this question, we included transformations of both artifacts and animals in our studies to uncover what is unique about the way that we reason about objects in these different domains.

2) **Cause of the transformation.** Prior work has also not systematically examined whether people's intuitions about individual persistence depend on the causal mechanism of the transformation. Previous studies have focused on transformations involving supernatural (e.g., a magic fairy) or science-fictional (e.g., an atom reassembler, a transporter, a brain transplant) causes (see Leonard & Rips, 2015, for an exception). The mechanisms involved in these transformations are underspecified (e.g., it is unclear exactly *how* a fairy could transform a pumpkin into a carriage). As a result, adults' tendency to ascribe individual persistence in such cases may stem from a belief that *anything is possible* in the realm of science fiction or the supernatural.

To address this concern, we examined people's ascriptions of individual persistence following real-world kind-altering changes (e.g., metamorphosis in animals, disassembly and kind-altering reassembly in artifacts). Such transformations have domain-specific causal mechanisms: Metamorphosis in animals occurs spontaneously (i.e., via a biologically-driven process), whereas disassembly and reassembly in artifacts occurs through human intervention (i.e., an external process). Therefore, children and adults should expect only certain kinds of transformations (i.e., ones with domain-appropriate causal mechanisms) to be possible in the real world (see Rosengren, Gelman, Kalish, & McCormick, 1991, for a study about children's understanding of growth and metamorphosis). We predict that participants' tendency to attribute individual persistence

will be stronger when the transformation has a cause that is domain appropriate (i.e., spontaneous for animals and externally caused for artifacts) than when the transformation has a cause that is *not* domain appropriate (i.e., externally caused for animals and spontaneous for artifacts). To examine this prediction, in our studies, we manipulated whether the causal mechanism of the transformation was appropriate for the domain.

3) **Consistency of labels.** Previous research has additionally not explored whether attributions of individual persistence depend on the label(s) used to speak about the object. There is prior evidence that using consistent labels to refer to distinct objects helps young children to form categories involving those objects (Gelman & Coley, 1990; Gelman & Markman, 1986; Graham, Keates, Vukatana, & Khu, 2012; Waxman & Braun, 2005). In particular, when researchers have used the same label for multiple objects, children overlook differences in surface appearance between the objects and extract deeper commonalities between them. In an analogous way, we reasoned that the use of a consistent count noun to refer to an object before and after a kind-altering transformation might help people (especially young children) to attribute individual persistence to the object. To examine this hypothesis, we compared attributions of individual persistence when we referred to the pre-event and post-event objects using either consistent or variable count nouns.

4) **Participants' age.** Finally, previous research has not thoroughly assessed whether people's ascriptions of individual persistence following kind-altering transformations increase with age. Only one previous study examined children's judgments of individual persistence following kind-altering change. In this prior research, Liittschwager (1994) found no significant difference between 4-year-olds' tendency to

attribute individual persistence following transformations of a person (e.g., a clean boy) by a fairy into a member of the same kind (e.g., a dirty boy) or a member of a different kind (e.g., a cat). Thus, children, like adults (Blok et al., 2005; Leonard & Rips, 2015; Rhemtulla & Hall, 2009; Rips et al., 2006), do not appear to rely on an object's kind for ascriptions of individual persistence, consistent with continuity accounts. In the current studies, we extended this prior research by exploring the influence of the object's kind domain, the cause of the transformation, and the consistency of the label(s) used to speak about the object on attributions of individual persistence following real-world transformations across development. To address whether there is an age-related change in attributions of individual persistence, we included both children and adults in our studies. We focused on 5-year-olds and 7-year-olds, in particular, because Keil (1989) observed an age-related change in attributions of kind persistence between these ages.

2.2 Current Studies

To examine the influence of the four preceding factors on ascriptions of individual persistence, we presented participants with stories about familiar objects that underwent an event that either preserved or altered their kind: For instance, participants heard about a dog that remained a dog or about a caterpillar that turned into a butterfly. We manipulated the object's *kind domain* by including stories about both artifacts and animals in our studies. Following the events, we queried participants about *kind* persistence using a count noun (e.g., "Is this a CATERPILLAR?") in Study 1 or about *individual* persistence using a proper name (e.g., "Is this ANNIE?") in Studies 2 to 4.

In Studies 2 and 3, we examined the influence of the *cause of the transformation*. In Study 2, participants heard stories describing transformation events with domain-

appropriate causes (i.e., spontaneously occurring for animals and externally caused for artifacts). In Study 3, in contrast, participants heard stories describing transformations with causes that were *not* appropriate for the domain (i.e., externally caused for animals and spontaneously occurring for artifacts). In Study 4, we examined the role of *consistent labels* in fostering attributions of individual persistence: Half the participants heard the pre- and post-event objects described using the same count noun and the other half heard the pre- and post-event objects described using different count nouns. In all studies, we compared adults' and children's (5- and 7-year-olds) responses in order to assess whether the *participants' age* influenced attributions of persistence.

With respect to the factors under exploration in this study, we predicted that participants would (1) be more likely to attribute individual persistence to an animal than to an artifact following kind-altering events, because children and adults would expect an animal's (but not an artifact's) essence to provide a principle of persistence through change; (2) have a stronger tendency to attribute individual persistence to an object when the causal mechanism of the transformation was appropriate for the domain (i.e., spontaneously occurring for animals and externally caused for artifacts) than when it was *not* appropriate for the domain (i.e., externally caused for animals and spontaneously occurring for artifacts); (3) be more likely to ascribe individual persistence to an object when it was described using consistent rather than variable count nouns; and (4) be more likely to attribute individual persistence to an object following kind-altering changes with increasing age – specifically, we expected 7-year-olds and adults, but not 5-year-olds, to judge objects to persist as the same individual following kind-altering transformations (cf. Keil, 1989).

2.3 Study 1

To assess whether our manipulation of an object's kind membership across the kind-preserving and kind-altering events was successful, we first examined children's and adults' judgments of *kind* persistence following the events.

2.3.1 Method

2.3.1.1 Participants. Sixteen English-speaking undergraduates ($M_{\text{age}} = 21.56$ years, $SD = 3.95$, 68.75% female) received course credit for participating. Sixteen English-speaking 5-year olds ($M_{\text{age}} = 66.69$ months, $SD = 3.77$, 50% female) and sixteen English-speaking 7-year olds ($M_{\text{age}} = 90.94$ months, $SD = 3.17$, 50% female) also took part. One additional 5-year-old was tested, but not included in the final sample due to sibling interference.

2.3.1.2 Materials. We created eight stories, each focused on a different object. Four stories were about a familiar kind of animal (i.e., dog, turtle, caterpillar, and tadpole) and four stories were about a familiar kind of artifact (i.e., hammer, motorcycle, table, and jeans). Furthermore, four of the stories involved a *kind-preserving* event and four involved a *kind-altering* event. There were thus two stories for each of the following types of events: 1) *animal kind-preserving*, 2) *animal kind-altering*, 3) *artifact kind-preserving*, and 4) *artifact kind-altering* (see Figure 2.1 for an example of each of the four types of events). The stories were presented on a computer using a PowerPoint presentation that consisted of three slides. The slides included animated visuals to show the events.

2.3.1.3 Procedure. Adults sat at a table in small groups across from the experimenter and provided written answers to all questions. Children were tested

individually and responded to all questions verbally. Each story consisted of three phases: object introduction, transformation event, and test event.

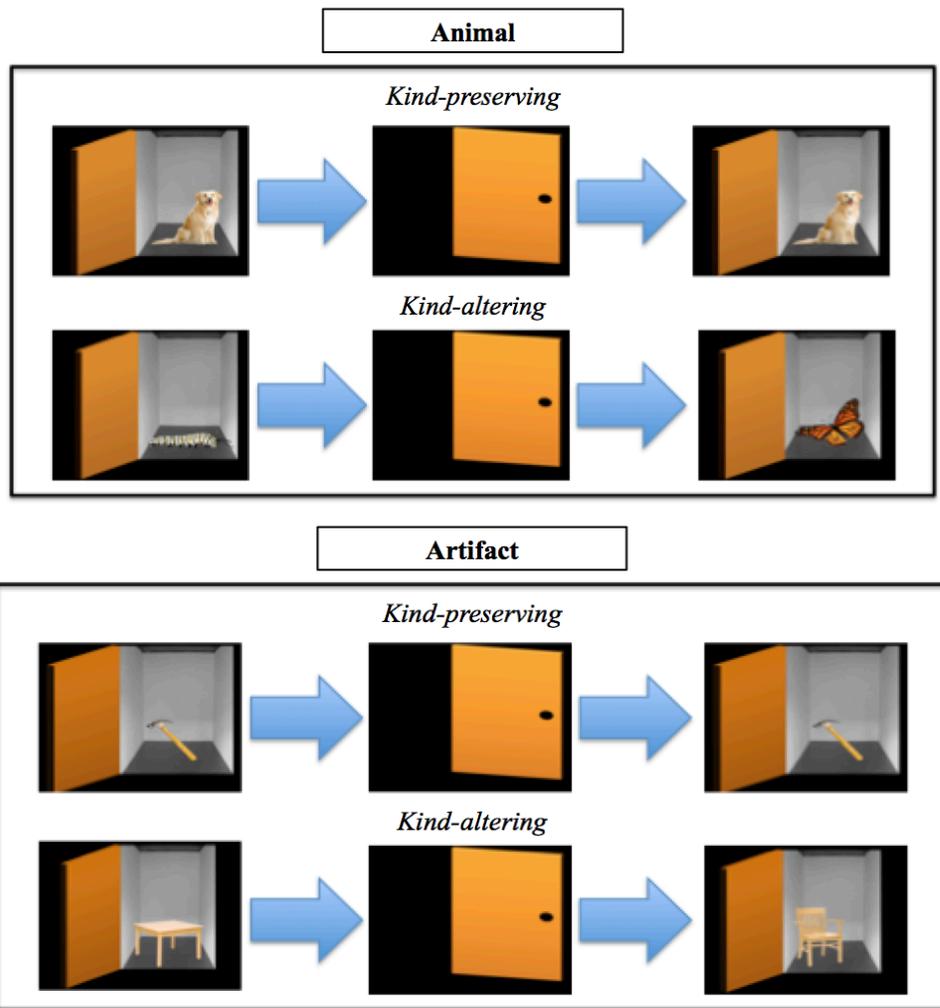
1) Object introduction. The experimenter presented participants with the first slide of the story, which included a picture of an object (e.g., a caterpillar). The experimenter labeled the object's kind with a familiar count noun (e.g., "This is a CATERPILLAR") (see Appendix A for an example script). Participants were then asked to repeat the count noun. Next, the experimenter used a familiar proper name to label the object (e.g., "This CATERPILLAR is called ANNIE"). Participants were also asked to repeat the proper name.

2) Transformation event. The experimenter next showed the second slide, which included a picture of an empty room. The experimenter stated that there was nothing in the room. A picture of the original object appeared in the room via animation, and the experimenter stated that he placed the object in the room and went away for many weeks. The slide was then animated to show the door to the room closing.

The experimenter next described what happened while he was away. All events were described as involving transformations with causal mechanisms that were appropriate for the domain (i.e., spontaneously occurring for animals and externally caused for artifacts). In the animal stories, the experimenter told participants that "nobody came to the room" and that "nobody touched what was in the room for many weeks". In contrast, in the artifact stories, the experimenter told participants that "somebody came to the room". The slide was animated so that they saw a man enter the room, and then close the door behind him. Additionally, the experimenter said that the "person worked on what was in the room for many weeks".

The experimenter next presented the third slide, which included an animated picture of the door to the room opening to reveal the post-event object. This object was either the same kind of thing or a different kind of thing than the original object. For the artifact story, the slide was animated to show the man exiting the room. In the *kind-preserving* events, the post-event object was identical in appearance to the original object (i.e., the same kind of thing). For example, in one of the animal *kind-preserving* events, a dog was placed in the room and the post-event object was an identical-looking dog. In one of the artifact *kind-preserving* events, a hammer was placed in the room and the post-event object was an identical-looking hammer. In contrast, for the *kind-altering* events, the post-event object was a member of a different kind than the original object. For example, in one of the animal *kind-altering* events, a caterpillar was placed in the room and the post-event object was a butterfly: A transformation that is possible via spontaneous metamorphosis. In one of the artifact *kind-altering* events, a table was placed in the room and the post-event object was a (similar-sized) chair: A transformation that is possible through the intervention of a person, for example, through a carpenter taking apart a table and constructing a chair from the parts.

Figure 2.1. Schematic of Transformation Events.



3) *Test event.* Participants were queried about *kind* persistence, using the count noun they heard at the outset (e.g., "Is this a CATERPILLAR?"). We recorded whether participants said "yes" to this question as an indication of their attributions of kind persistence.

The stories were presented in semi-random order, such that half the participants saw an animal story on the first trial and the other half saw an artifact story. In addition, half the stories on the first trial were *kind preserving* and half were *kind altering*.

2.3.2 Results and Discussion

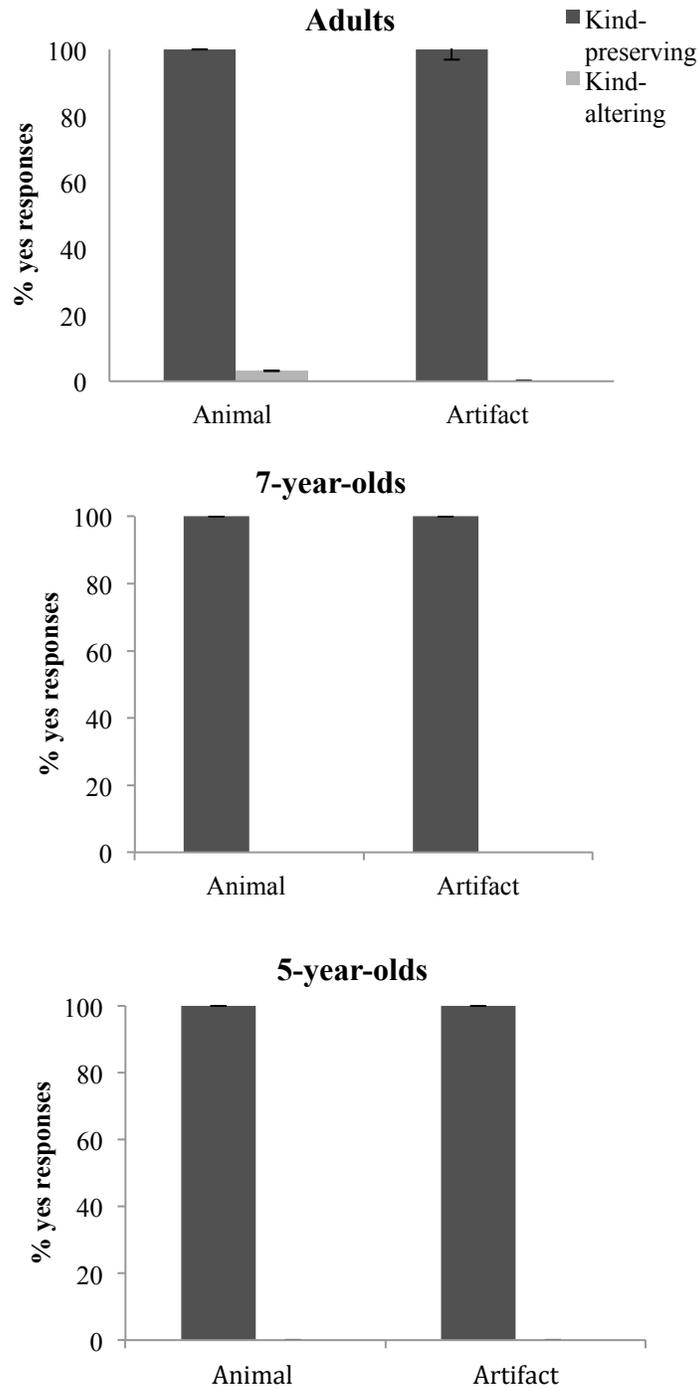
A preliminary analysis revealed no difference in judgments between the two stories of each of the four types of test events in this or any subsequent study (based on paired-samples *t*-tests, all *p*'s > .05 with Bonferroni-Holm correction for multiple comparisons³). Thus, for each participant, we computed the percentage of "yes" responses (indicating attributions of persistence) for kind-preserving and kind-altering events for both animal and artifact trials. Each percentage was based on a total of two questions (i.e., two stories for each type of event).

As expected, participants' judgments of kind persistence depended on the kind of the post-event object for both animals and artifacts (see Figure 2.2). For animals, when the event was *kind preserving*, 5-year-olds, 7-year-olds, and adults judged the post-event object to be the same kind of thing 100% of the time. In contrast, for the *kind-altering* events, participants almost never (i.e., only on one trial) judged the post-event object to be the same kind of thing. The pattern of responses was the same for artifacts: When the event was *kind preserving*, 5-year-olds, 7-year-olds, and adults judged the post-event object to be the same kind of thing 100% of the time. In contrast, for the *kind-altering* events, participants never judged the post-event object to be the same kind of thing.

³ In this dissertation, *p*-values will be reported relative to conventional anchors (e.g., $p > .05$, $p < .01$, $p < .001$), except when the *p*-value is between .01 and .10. In these cases, exact *p*-values will be reported.

Figure 2.2. Children's and Adults' Attributions of Kind Persistence in Study 1.

Percentage of trials in which adults (top panel), 7-year-olds (middle panel), and 5-year-olds (bottom panel) responded "yes". Error bars represent one standard error.



Participants' judgments of kind persistence were virtually categorical: When the object's kind was preserved, children and adults always judged both animals and artifacts to be the same kind of thing. In contrast, when the object's kind was altered, for both animals and artifacts, children and adults almost never judged them to be the same kind of thing. This data demonstrate that participants of all ages reasoned about an object's kind persistence as we expected they would (cf. Liittschwager, 1994, who did not collect kind persistence judgments and thus had no check on children's ability to follow her task appropriately). The results of Study 1 set the stage for a clear examination of people's attributions of individual persistence following kind-preserving and kind-altering events. In Study 2, we therefore examined children's and adults' judgments of *individual* persistence following the same events.

2.4 Study 2

2.4.1 Method

2.4.1.1 Participants. Sixteen English-speaking undergraduates ($M_{\text{age}} = 20.75$, $SD = 3.24$, 68.75% female) received course credit for participating. Sixteen English-speaking 5-year olds ($M_{\text{age}} = 65.38$ months, $SD = 3.48$, 50% female) and sixteen English-speaking 7-year olds ($M_{\text{age}} = 90.88$ months, $SD = 3.50$, 50% female) also took part. One additional adult was tested, but not included in the final sample due to inattention.

2.4.1.2 Materials. The materials were the same as in Study 1.

2.4.1.3 Procedure. The procedure was similar to Study 1. In Study 2, however, participants were queried not about the *kind* persistence, but rather about the *individual* persistence of the object following the event, using the proper name they had heard (e.g.,

"Is this ANNIE?"). We recorded whether participants said "yes" to this question as an indication of their attributions of individual persistence.

2.4.2 Results and Discussion

We first conducted a repeated-measures analysis of variance (ANOVA) of the percentage of "yes" responses, with transformation type (kind-preserving or kind-altering) and domain of the object (animal or artifact) as within-subjects factors and age of the participant (5-year-olds, 7-year-olds, or adults) as a between-subjects factor. We observed main effects of transformation type, $F(1, 45) = 51.60, p < .001, \eta_p^2 = .53$, domain of the object, $F(1, 45) = 23.83, p < .001, \eta_p^2 = .35$, and age of the participant, $F(2, 45) = 5.74, p < .01, \eta_p^2 = .20$. Additionally, we observed significant two-way interactions between transformation type and domain, $F(1, 45) = 13.64, p < .001, \eta_p^2 = .23$, and between transformation type and age of the participant, $F(2, 45) = 5.38, p < .01, \eta_p^2 = .19$. No other interactions were significant. Because we observed a significant interaction involving age, we next examined adults', 7-year-olds' and 5-year-olds' responses separately.

Adults. Adults' judgments of individual persistence depended on the kind of the post-event object for artifacts, but not for animals. For animals, adults judged the post-event object to be the same individual 100% of the time, regardless of whether the event was *kind preserving* or *kind altering* (see top panel of Figure 2.3). For artifacts, in contrast, adults were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 2.76, p = .01, d = 0.69$. Their percentage of "yes" responses was significantly greater than chance (indicating systematic attributions of individual persistence) when the event was *kind*

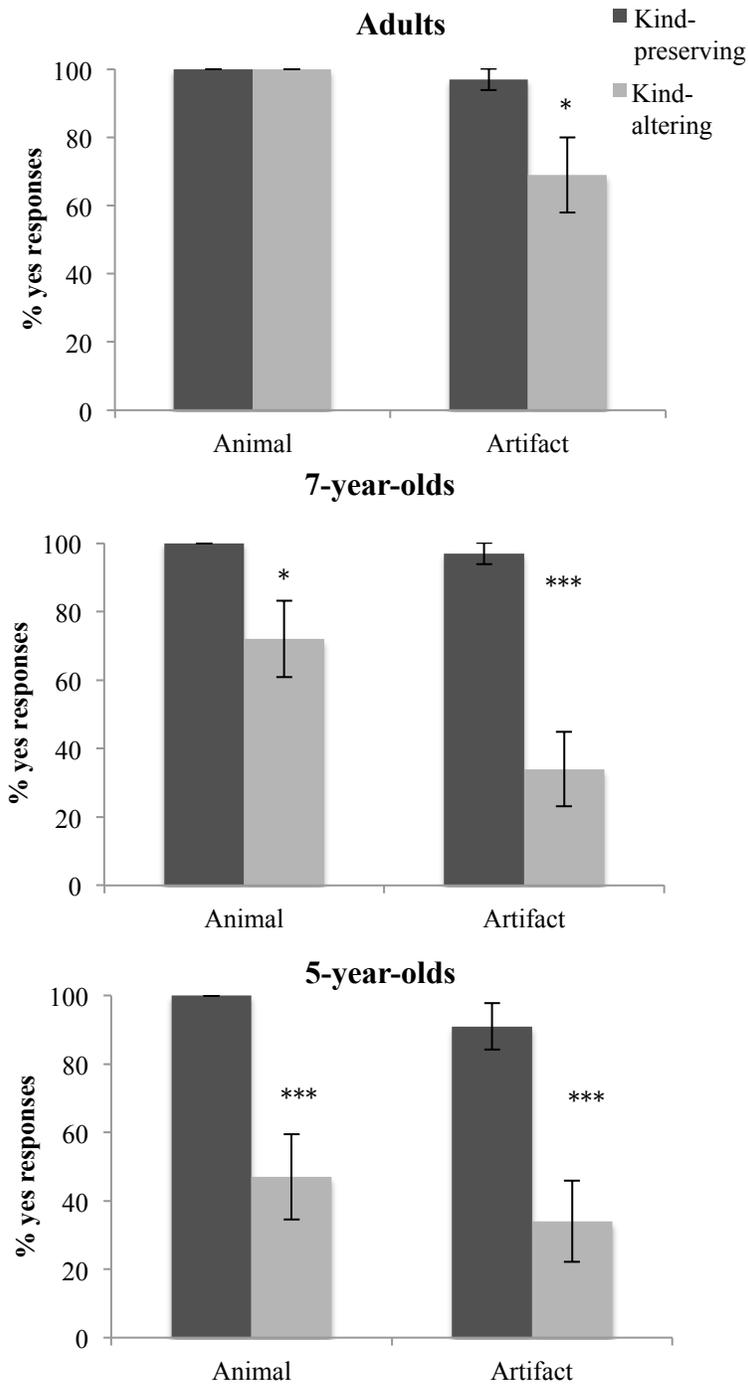
preserving, $t(15) = 15.00$, $p < .001$ [one-tailed], $d = 3.75$; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = 1.70$, $p = .06$ [one-tailed], $d = 0.42^4$.

⁴ In this dissertation, we use one-tailed t -tests when we predicted results in a particular direction — specifically, situations in which we expected participants to systematically judge the object to persist as the same individual following the transformation event.

Figure 2.3. Children's and Adults' Attributions of Individual Persistence in Study 2.

Percentage of trials in which adults (top panel), 7-year-olds (middle panel), and 5-year-olds (bottom panel) responded "yes". Error bars represent one standard error; * $p < .05$;

*** $p < .001$.



7-year-olds. Seven-year-olds' pattern of attributions of individual persistence was similar to that of adults' (see middle panel of Figure 2.3). Unlike adults, however, 7-year-olds' responses for animals depended on the kind of the post-event object: They were more likely to judge the object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 2.52, p = .02, d = 0.63$. Like adults, the percentage of "yes" responses was significantly greater than chance whether the event was *kind preserving* (exactly 100%) or *kind altering*, $t(15) = 1.96, p = .03$ [one-tailed], $d = 0.49$. For artifacts, also like adults, 7-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 5.37, p < .001, d = 1.34$. In addition, their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving*, $t(15) = 15.00, p < .001$ [one-tailed], $d = 3.75$; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = -1.43, p = .09$ [one-tailed], $d = 0.36$.

5-year-olds. Five-year-olds' pattern of responses for animals differed from that of 7-year-olds and adults (see bottom panel of Figure 2.3). For animals, 5-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 4.26, p < .001, d = 1.06$. Unlike adults and 7-year-olds, however, their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving* (exactly 100%), but it was *not* significantly greater than chance when the event was *kind altering*, $t(15) = -0.25, p > .05$ [one-tailed], $d = 0.06$, suggesting that they did not systematically judge an animal to be the same individual following a kind-altering change. For artifacts, however, like adults and 7-year-olds, 5-year-olds were more likely to judge the post-event object to be

the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 4.70, p < .001, d = 1.18$. In addition, their percentage of "yes" responses was significantly greater than chance when the event was kind preserving, $t(15) = 5.98, p < .001$ [one-tailed], $d = 1.49$; but it was not significantly greater than chance when the event was kind altering, $t(15) = -1.32, p = .10$ [one-tailed], $d = 0.33$.

Overall, we found that when the transformation was kind preserving, children and adults judged both animals and artifacts to be the same individuals. In contrast, when the transformation was kind altering, 5-year-olds did *not* systematically judge either animals or artifacts to be the same individuals, whereas 7-year-olds and adults judged animals, but did *not* systematically judge artifacts, to be the same individuals.

The results of the current study differ from those of previous studies, which have found that children and adults judge an object to persist as the same individual following kind-altering changes, consistent with continuity accounts (Blok et al., 2005; Leonard & Rips, 2015; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006). The difference between the results may stem from the fact that prior studies had a limited focus. In particular, they examined participants' attributions of persistence following transformations based on science fiction or the supernatural (see Leonard & Rips, 2015, for an exception). The data from the current study are consistent with the possibility that participants in prior studies overlooked changes to an object's kind when making attributions of individual persistence simply because they believed that *anything was possible* in the realm of science fiction or the supernatural. In contrast, our results suggest that participants' pattern of attributions of individual persistence following real-world transformations are more constrained by the objects' kinds.

The data from Study 2 show that attributions of individual persistence are influenced not only by an object's kind, but also by an object's kind domain and the age of the participant. In particular, young children (5-year-olds) relied on an object's kind persistence for attributions of individual persistence for both animals and artifacts, consistent with the sortalist account. In contrast, 7-year-olds and adults did not rely on an object's kind for attributions of individual persistence for animals, consistent with continuity accounts. For artifacts, however, older children and adults relied on an object's kind persistence, consistent with the sortalist account. In the General Discussion, we will return to an examination of possible explanations for this domain difference and age-related change.

2.5 Study 3

In Study 3, we examined the role of the inferred causal mechanism of the transformation in attributions of individual persistence. To address this issue, in Study 3, we simply swapped the causal mechanism of the animal and the artifact transformation events from Study 2: The animal transformations were now described as externally caused, whereas the artifact transformations were described as spontaneously occurring. As previously discussed, we expected participants to have a stronger tendency to attribute individual persistence when the causal mechanism of the transformation was appropriate for the domain (i.e., in Study 2) than when it was not appropriate for the domain (i.e., in Study 3).

2.5.1 Method

2.5.1.1 Participants. Sixteen English-speaking undergraduates ($M_{\text{age}} = 21.16$, $SD = 3.58$, 68.75% female) received course credit for participating. Sixteen English-speaking

5-year olds ($M_{\text{age}} = 66.15$ months, $SD = 3.50$, 50% female) and sixteen English-speaking 7-year olds ($M_{\text{age}} = 90.91$ months, $SD = 3.29$, 50% female) also took part.

2.5.1.2 Materials. The materials were the same as in Study 1.

2.5.1.3 Procedure. The procedure was the same as that of Study 2, with one small difference. The transformation events for the animal stories were now described as having an external cause. The experimenter told participants that "somebody came to the room". The PowerPoint slide was animated to show a man entering the room, and then closing the door behind him. The experimenter then said that the "person worked on what was in the room for many weeks". For the artifact stories, in contrast, the transformation events were now described as spontaneously occurring. The experimenter told participants that "nobody came to the room" and that "nobody touched what was in the room for many weeks".

2.5.2 Results and Discussion

We first conducted a repeated-measures ANOVA of the percentage of "yes" responses, with transformation type (kind-preserving or kind-altering) and domain of the object (animal or artifact) as within-subjects factors and age of the participant (5-year-olds, 7-year-olds, or adults) as a between-subjects factor. We observed main effects of transformation type, $F(1, 45) = 85.41, p < .001, \eta_p^2 = .65$, and domain of the object, $F(1, 45) = 86.94, p < .001, \eta_p^2 = .66$. In contrast, we did not observe a main effect of the age of the participant, $F(2, 45) = 0.92, p > .05, \eta_p^2 = .04$. Additionally, we observed significant two-way interactions between transformation type and domain, $F(1, 45) = 86.94, p < .001, \eta_p^2 = .66$, and between domain and age of the participant, $F(2, 45) = 27.70, p < .001, \eta_p^2 = .55$. There was also a significant three-way interaction between the

factors, $F(2, 45) = 27.70, p < .001, \eta_p^2 = .55$. Because we observed significant interactions involving age, we examined adults', 7-year-olds' and 5-year-olds' responses separately in the following analyses, as in Study 2.

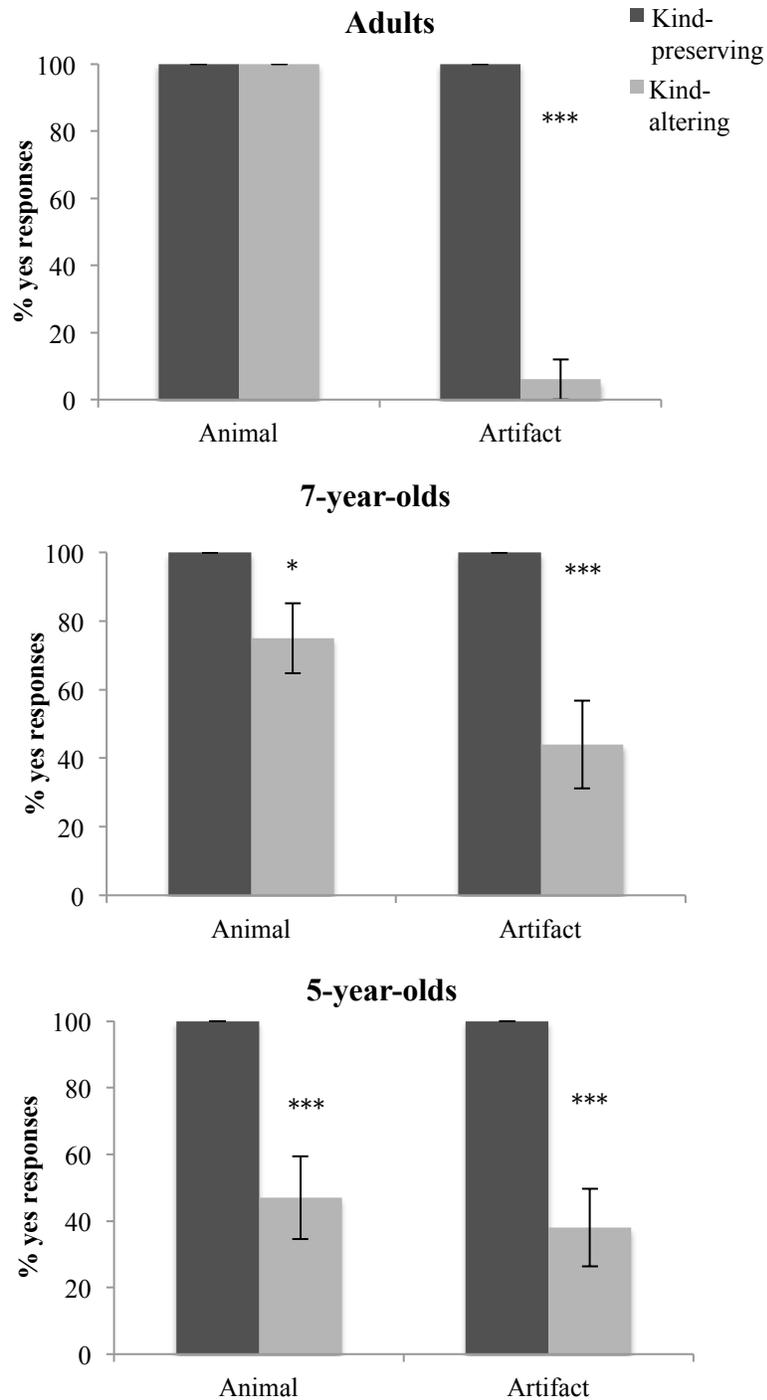
Overall, the pattern of results in this study replicated the results from Study 2, with one exception: Adults now judged that an artifact *did not* persist as the same individual following a domain inconsistent (i.e., spontaneous) kind-altering transformation.

Adults. As in Study 2, adults' judgments of individual persistence depended on the kind of the post-event object for artifacts, but not for animals (see top panel of Figure 2.4). For animals, adults judged the post-event object to be the same individual 100% of the time, regardless of whether the event was *kind preserving* or *kind altering*. For artifacts, in contrast, adults' judgments of persistence depended on the kind of the post-event object. They were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 15.00, p < .001, d = 3.75$. Their percentage of "yes" responses was exactly 100% when the event was *kind altering*, but unlike the results of Study 2, adults responses were significantly below chance (indicating that they systematically judged that the individual did *not* persist) when the event was *kind altering*, $t(15) = -7.00, p < .001$ [one-tailed], $d = 1.75$.

Figure 2.4. Children's and Adults' Attributions of Individual Persistence in Study 3.

Percentage of trials in which adults (top panel), 7-year-olds (middle panel), and 5-year-olds (bottom panel) responded "yes". Error bars represent one standard error; * $p < .05$;

*** $p < .001$.



7-year-olds. Seven-year-olds' pattern of responses in Study 3 was the same as their pattern of responses in Study 2 (see middle panel of Figure 2.4). Seven-year-olds were more likely to judge the object to be the same individual when the event was kind preserving than when it was kind altering, $t(15) = 2.45, p = .03, d = 0.61$. Yet the percentage of "yes" responses was significantly greater than chance *regardless* of whether the transformation was *kind preserving* (exactly 100%) or *kind altering*, $t(15) = 2.45, p = .01$ [one-tailed], $d = 0.61$. In contrast, for artifacts, 7-year-olds were more likely to judge the post-event object to be the same individual when the transformation was *kind preserving* than when it was *kind altering*, $t(15) = 4.39, p < .001, d = 1.10$. Their percentage of "yes" responses was significantly greater than chance when the transformation was kind preserving (exactly 100%); but it was not significantly greater than chance when the transformation was kind altering, $t(15) = -0.49, p > .05$ [one-tailed], $d = 0.12$.

5-year-olds. Like 7-year-olds, 5-year-olds' pattern of responses in Study 3 was the same as their pattern of responses in Study 2 (see bottom panel of Figure 2.4). For animals, 5-year-olds were more likely to judge the post-event object to be the same individual when the transformation was kind preserving than when it was kind altering, $t(15) = 4.26, p < .001, d = 1.06$. Their percentage of "yes" responses was significantly greater than chance when the transformation was kind preserving (exactly 100%), but it was not significantly greater than chance when the transformation was *kind altering*, $t(15) = -0.25, p > .05$ [one-tailed], $d = 0.06$. For artifacts, in contrast, 5-year-olds were more likely to judge the post-event object to be the same individual when the transformation was *kind preserving* than when it was *kind altering*, $t(15) = 5.37, p < .001,$

$d = 1.34$. Their percentage of "yes" responses was exactly 100% when the event was *kind preserving*; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = -1.07$, $p > .05$ [one-tailed], $d = 0.27$.

The results of this study show that participants' attributions of individual persistence were not affected by the implied causal mechanism of the transformation, with one exception: Adults did *not* judge an artifact to persist as the same individual following a spontaneous transformation. Thus, it appears, contrary to our prediction, that participants were not generally less likely to ascribe individual persistence to an object when the causal mechanism for the transformation was inappropriate for the domain (i.e., externally caused for animals and spontaneously occurring for artifacts). In the General Discussion, we offer an explanation for why the implied causal mechanism might not have influenced attributions of individual persistence, especially for animals.

2.6 Study 4

To examine the role of the consistency of the labels used to speak about an object in attributions of individual persistence, we manipulated whether we referred to the pre- and post-event objects using the same or variable count nouns. For example, we described a spontaneous caterpillar/butterfly transformation using either the variable labels "caterpillar" and "butterfly" or the consistent label "insect". We expected that the use of a consistent count noun would help children to look beyond differences in the surface appearance (and differences in kind) between the pre- and post-event objects (see Gelman & Coley, 1990; Gelman & Markman, 1986; Graham et al., 2012; Waxman & Braun, 2005). When we described the pre- and the post-event object using a consistent label, but not a variable label, we expected that 5-year-olds would attribute individual

persistence to an animal following a kind-altering change. In other words, we predicted that a consistent label would boost the performance of younger children (5-year-olds) to be like that of older children (7-year-olds) and adults. We did not, however, predict that the use of a consistent label would increase attributions of individual persistence for artifacts following a kind-altering change, given the previous evidence in Studies 2 and 3 that neither children nor adults systematically attributed persistence to artifacts following kind-altering change.

2.6.1 Method

2.6.1.1 Participants. Thirty-two English-speaking undergraduates ($M_{\text{age}} = 19.94$, $SD = 2.03$, 78.13% female) received course credit for participating. Thirty-two English-speaking 5-year olds ($M_{\text{age}} = 65.78$ months, $SD = 3.24$, 50% female) and thirty-two English-speaking 7-year olds ($M_{\text{age}} = 88.13$ months, $SD = 2.88$, 50% female) also took part. Participants were randomly assigned in equal numbers to the *variable-labels* or the *consistent-labels* conditions. Two additional adults were tested, but not included in the final sample because they did not repeat the count noun used to label the object.

2.6.1.2 Materials. The materials were the same as in Study 1.

2.6.1.3 Procedure. The procedure was similar to that of Study 2. However, following the description of the transformation event, the experimenter now summarized what had happened using count noun labels. In the *variable-labels* condition, the experimenter used a count noun to refer to the object before the event and a different count noun to refer to the object after the event (e.g., for a spontaneous caterpillar/butterfly transformation, he said "I put a caterpillar in the room and there is a butterfly in the room"). In the *consistent-labels* condition, the experimenter used the same

count noun to refer to the object both before and after the event (e.g., for a spontaneous caterpillar/butterfly transformation, he said "I put an insect in the room and there is an insect in the room"). Note that all events were described as involving transformations with causal mechanisms that were appropriate for the domain, as in Study 2. As in Studies 2 and 3, we queried the *individual* persistence of the object using a proper name (e.g., "Is this ANNIE?").

2.6.2 Results and Discussion

We first conducted a repeated-measures ANOVA of the percentage of "yes" responses, with transformation type (kind-preserving or kind-altering) and domain of the object (animal or artifact) as within-subjects factors, and condition (*variable labels* or *consistent labels*) and age of the participant (5-year-olds, 7-year-olds, or adults) as between-subjects factors. We observed main effects of transformation type, $F(1, 90) = 98.66, p < .001, \eta_p^2 = .52$, domain of the object, $F(1, 90) = 46.32, p < .001, \eta_p^2 = .34$, age of the participant, $F(2, 90) = 4.83, p = .01, \eta_p^2 = .10$, and a non-significant main effect of condition, $F(1, 90) = 3.51, p = .06, \eta_p^2 = .04$. Additionally, we observed significant two-way interactions between transformation type and domain, $F(1, 90) = 48.69, p < .001, \eta_p^2 = .35$, transformation type and age of the participant, $F(2, 90) = 6.15, p < .01, \eta_p^2 = .12$, and domain and age of the participant, $F(2, 90) = 5.84, p < .01, \eta_p^2 = .11$. We also observed a significant three-way interaction between transformation type, domain, and age of the participant, $F(2, 90) = 8.14, p < .001, \eta_p^2 = .15$. No other interactions were significant. Because we were interested in the role of the labels used to speak about an object on attributions of individual persistence, we made an a priori decision to analyze the *variable labels* and the *consistent labels* conditions separately. Furthermore, because

we observed significant interactions involving age, we also examined adults', 7-year-olds' and 5-year-olds' responses in each condition separately, as in Studies 2 and 3.

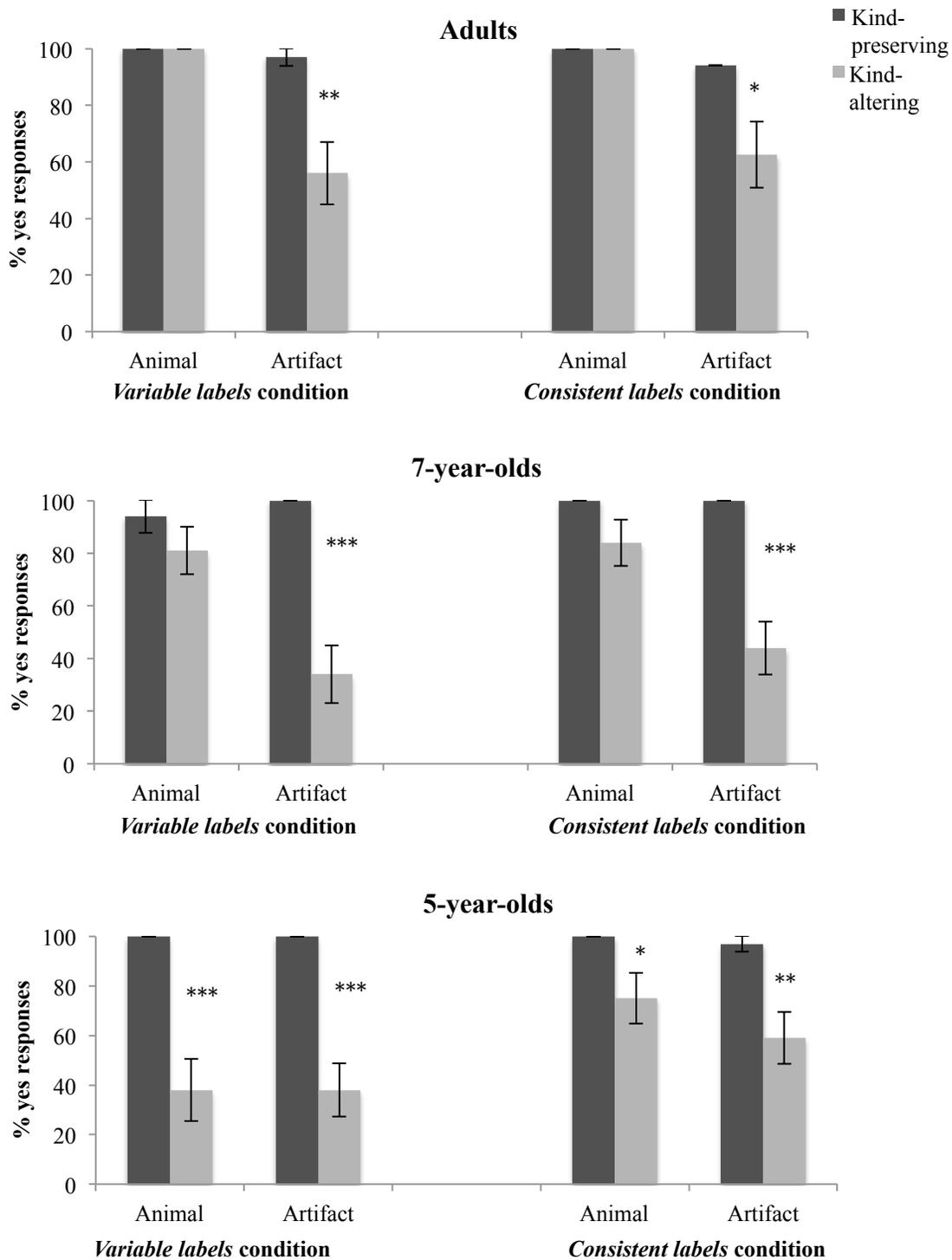
Variable-labels condition. In this condition, when we used a count noun to refer to the pre-event object and a different count noun to refer to the post-event object, adults and children showed exactly the same pattern of responses as in Study 2.

Adults. As in Study 2, adults' judgments of individual persistence depended on the kind of the post-event object for artifacts, but not for animals (see top left panel of Figure 2.5). For animals, adults judged the post-event object to be the same individual 100% of the time, regardless of whether the event was *kind preserving* or *kind altering*. For artifacts, in contrast, adults' judgments depended on the kind of the post-event object. They were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 3.31, p < .01, d = 0.83$. Their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving*, $t(15) = 15.00, p < .001$ [one-tailed], $d = 3.75$; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = 0.57, p > .05$ [one-tailed], $d = 0.14$.

Figure 2.5. Children's and Adults' Attributions of Individual Persistence in Study 4.

Percentage of trials in which adults (top panel), 7-year-olds (middle panel), and 5-year-olds (bottom panel) responded "yes". Error bars represent one standard error; * $p < .05$;

** $p < .01$, *** $p < .001$.



7-year-olds. Seven-year-olds' pattern of responses was essentially the same as their pattern of responses in Study 2 (see middle left panel of Figure 2.5). For animals, 7-year-olds were equally likely to judge the object to be the same individual when the event was *kind preserving* and *kind altering*, $t(15) = 1.07, p > .05, d = 0.27$. However, like adults, the percentage of "yes" responses was significantly greater than chance whether the event was *kind preserving*, $t(15) = 7.00, p < .001$ [one-tailed], $d = 1.75$, or *kind altering*, $t(15) = 3.48, p < .01$ [one-tailed], $d = 0.87$. For artifacts, 7-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 6.01, p < .001, d = 1.50$. Also like adults, their percentage of "yes" responses was exactly 100% when the event was *kind preserving*; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = -1.43, p = .09$ [one-tailed], $d = 0.36$.

5-year-olds. Five-year-olds' pattern of responses in the *variable-labels* condition was the same as their pattern of responses in Study 2 (see bottom left panel of Figure 2.5). For animals, 5-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 5.00, p < .001, d = 1.25$. Their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving* (exactly 100%); but it was not significantly greater than chance when the event was *kind altering*, $t(15) = -1.00, p > .05$ [one-tailed], $d = 0.25$. For artifacts, in contrast, 5-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 5.84, p < .001, d = 1.46$. Like adults and 7-year-olds, their percentage of "yes" responses was exactly 100% when the event was *kind*

preserving, but it was not significantly greater than chance when the event was kind altering, $t(15) = -1.17, p > .05$ [one-tailed], $d = 0.29$.

Consistent-labels condition. Unlike in the *variable-labels* condition, we now observed a different pattern of results. As predicted, when we used a consistent label for the animals, 5-year-olds now *systematically* judged the post-event objects to be the same individuals following a kind-altering transformation. In other words, the use of a consistent count noun to refer to the pre- and post-event object appeared to boost 5-year-olds' tendency to ascribe individual persistence following kind-altering changes, but only to animals, and not to artifacts.

Adults. As in Study 2, adults' judgments of individual persistence depended on the kind of the post-event object for artifacts, but not for animals (see top right panel of Figure 2.5). Adults judged the post-event object to be the same individual 100% of the time, regardless of whether the event was *kind preserving* or *kind altering*. For artifacts, in contrast, adults' judgments depended on the kind of the post-event object. They were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 2.83, p = .01, d = 0.71$. Their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving*, $t(15) = 7.00, p < .001$ [one-tailed], $d = 1.75$; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = 1.07, p > .05$ [one-tailed], $d = 0.27$.

7-year-olds. Seven-year-olds' pattern of responses in this condition was also essentially the same as their pattern of responses in Study 2 (see middle right panel of

Figure 2.5). For animals, they were equally likely to judge the object to be the same individual when the event was *kind preserving* or *kind altering*, $t(15) = 1.78$, $p = .10$, $d = 0.44$. Their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving* (exactly 100%) and *kind altering*, $t(15) = 3.91$, $p < .001$ [one-tailed], $d = 0.98$. For artifacts, 7-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 5.58$, $p < .001$, $d = 1.40$. In addition, their percentage of "yes" responses was exactly 100% when the event was *kind preserving*; but it was not significantly greater than chance when the event was *kind altering*, $t(15) = -0.62$, $p > .05$ [one-tailed], $d = 0.16$.

5-year-olds. Five-year-olds' patterns of responses in the *consistent-labels* condition showed a striking difference from their pattern of responses in Study 2 and from their pattern of responses in the *variable-labels* condition of Study 4. They now *systematically* judged an animal to be the same individual following a kind-altering change (see bottom right panel of Figure 2.5). For animals, 5-year-olds were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 2.45$, $p = .03$, $d = 0.61$. Unlike in Study 2 or in the *variable-labels* condition of Study 4, however, their percentage of "yes" responses was significantly greater than chance *both* when the event was *kind preserving* (exactly 100%) *and* when it was *kind altering*, $t(15) = 2.45$, $p = .01$ [one-tailed], $d = 0.61$. For artifacts, in contrast, 5-year-olds pattern of responses was the same as in Study 2. They were more likely to judge the post-event object to be the same individual when the event was *kind preserving* than when it was *kind altering*, $t(15) = 3.87$, $p < .01$, $d = 0.97$.

Their percentage of "yes" responses was significantly greater than chance when the event was *kind preserving*, $t(15) = 15.00$, $p < .001$ [one-tailed], $d = 3.75$; but it was *not* significantly greater than chance when the event was *kind altering*, $t(15) = 0.90$, $p > .05$ [one-tailed], $d = 0.22$.

To examine the influence of the consistency of labels on attributions of individual persistence, we compared the percentage of "yes" responses between the *variable-labels* and the *consistent-labels* condition for each age group and for each type of event independently. We observed a significant difference only for 5-year-olds' responses for animal kind-altering events. (All other independent samples *t*-tests were not significant, all p 's $> .05$.) Five-year-olds in the *consistent-labels* condition were significantly more likely than 5-year-olds in the *variable-labels* condition to judge the post-event object to be the same individual, $t(30) = 2.32$, $p = .03$, $d = 0.82$.

As predicted, we found that the use of a *consistent* label to describe an animal before and after a kind-altering transformation significantly enhanced 5-year-olds' tendency to judge an animal, but not an artifact, to persist as the same individual. In contrast, when participants heard *variable* labels used to describe the pre- and post-event objects, they responded in the same way as in Study 2. This data suggests that when labels are not explicitly provided to describe the transformation, that young children naturally interpret the event as involving different (basic-level) kinds. The use of consistent labels therefore boosted 5-year-olds' attributions of individual persistence for animals to be like those of 7-year-olds' and adults'. In particular, it may have facilitated 5-year-olds' ability to look beyond the difference in the pre- and post-event animals' (basic-

level) kinds. In the General Discussion, we return to an examination of why consistent labels might influence attributions of individual persistence.

2.7 General Discussion

We examined 5-year-olds', 7-year-olds', and adults' attributions of individual persistence to objects following common kind-preserving and kind-altering changes (i.e., disassembly and kind-altering reassembly in artifacts and metamorphosis in animals). In particular, we focused on the disputed issue of whether an object must remain the same kind of thing in order for people to judge it to be the same individual. Across four studies, we assessed the influence of four unexamined factors on people's attributions of individual persistence: (1) the object's kind domain, (2) the causal mechanism of the transformation, (3) the consistency of the label(s) used to speak about the object, and (4) the participants' age.

When the transformation was kind preserving, children and adults judged both artifacts and animals to be the same individuals, regardless of the transformation's cause. When the transformation was kind altering, in contrast, there was a striking difference in patterns of responses across ages: Five-year-olds did *not* systematically judge either artifacts or animals to be the same individuals, regardless of the transformation's cause. We observed, however, that the use of a consistent label to describe an object undergoing a kind-altering transformation led 5-year-olds to systematically judge an animal, but not an artifact, to be the same individual. In contrast, adults and 7-year-olds judged animals, but did *not* systematically judge artifacts, to be the same individuals following these events, regardless of the transformation's cause. Adults were, nevertheless, more likely to ascribe persistence to artifacts after transformations with domain-appropriate causes (i.e.,

external) than after transformations with causes that were *not* domain appropriate (i.e., spontaneous).

Unlike prior studies that used transformations based on science fiction or the supernatural (Blok et al., 2005; Liittschwager, 1994; Rhemtulla & Hall, 2009; Rips et al., 2006), we found that there was an age-related change in the criteria that guide attributions of individual persistence following real-world transformations. In particular, our results show that there is a shift from an initial dependence on the persistence of an object's kind (consistent with the sortalist account) to an independence from this constraint (consistent with continuity accounts), but only if the kind domain of the object provides a principle of persistence through change (i.e., for animals). In this way, the data show that the criteria that guide attributions of individual persistence following real-world transformations depend on more than simply the persistence of an object's kind. We now discuss the influence of each of the four factors that we explored on attributions of individual persistence.

1) **Object's kind domain.** First, we observed a clear influence of an object's kind domain on attributions of its individual persistence. Both 7-year-olds and adults (but not 5-year-olds) were more likely to attribute individual persistence to an animal than an artifact following a kind-altering transformation. The pattern of attributions of *individual* persistence in our study is similar to the pattern of attributions of *kind* persistence observed in Keil (1989). In his study, 7-year-olds and adults (but not 5-year-olds) judged members of animal kinds, but not members of artifact kinds, to persist as the same *kind of thing* following transformations that altered their surface appearance.

Together, these results suggest that there is a fundamental distinction in how people reason about the persistence of animals and artifacts. There are at least two possible explanations for this domain difference. The first is simply that participants are more familiar with the types of kind-altering changes that animals can undergo. For example, it is possible that people have seen/heard discussion about animals undergoing metamorphosis (e.g., a caterpillar transforming into a butterfly) more often than they have seen/heard conversation about a person altering an artifact (e.g., a carpenter turning a table into a chair). While we cannot rule out the potential impact of domain differences in transformation familiarity on our results, we expect that children as young as five years are familiar with at least some kind-altering transformations of artifacts (e.g., through experience with toys, such as Transformers or Legos). We also believe that adults are quite familiar with a wide range of kind-altering artifact transformations. Yet even the adults in our study did not *systematically* attribute individual persistence to artifacts following kind-altering transformations, suggesting that familiarity alone cannot account for our results.

Instead, we hypothesize that the domain difference is more likely to stem from a distinction in the underlying structure of the representations of animal and artifact kinds. Extensive previous research has shown that people represent objects in these domains in different ways (see Gelman, 2003, for a review). In particular, they believe that members of animal kinds possess a deep essence (e.g., DNA or some other internal property), whereas they believe that members of artifact kinds possess a shallow essence related to the creator's intended function (see Keil, 1989; Kelemen & Carey, 2007). In our study, older children and adults may have judged an animal to persist as the same individual

following a kind-altering change because they believed that its essence provided a principle of individual persistence through change (cf. Gelman, 2003). In contrast, participants of all ages may *not* have systematically judged an artifact to persist as the same individual following a kind-altering transformation because they believed that an artifact's essence did *not* provide a principle of persistence through kind-altering change. Our data are therefore consistent with the proposal that people expect an animal's, but not an artifact's, essence to provide a principle of persistence through change.

2) **Cause of the transformation.** Contrary to our predictions, we found that the implied causal mechanism of the transformation did not influence participants' attributions of individual persistence, with one exception. Adults showed a systematic tendency to judge an artifact *not* to persist as the same individual following a transformation with a domain-inappropriate (i.e., spontaneous) cause. It appears that adults have clear expectations about the types of transformations that are impossible for artifacts. For example, they seem to know that tables do not metamorphose into chairs. Children, in contrast, were equally likely to judge artifacts to be the same individuals following both externally caused and spontaneously occurring kind-altering transformations. It thus appears that they do not have the same expectations as adults about the types of transformations that are possible, perhaps because they are less familiar with the kind-altering changes that artifacts undergo.

In contrast, we observed no influence of the implied causal mechanism of the transformation on attributions of individual persistence for animals. It is possible that 7-year-olds and adults judged an animal to persist through externally caused transformations because they believe that a person could surgically alter an animal (e.g., a

caterpillar) to make it look like another animal (e.g., a butterfly). In contrast, people may judge an animal to persist through externally caused changes, because they believe that the animal remained alive throughout the transformation. In other words, the inferred life status of the post-event object (i.e., whether the animal was thought to be dead or alive) may be more important than the inferred causal mechanism of the transformation in influencing attributions of individual persistence for animals (cf. Hall, 1998). We favor the second possibility, because even young children expect animals to remain alive through change (see Hatano, Siegler, Richards, Inagaki, Stavy, & Wax, 1993; Inagaki & Hatano, 1996). It is thus more likely that our participants used this knowledge to guide their attributions of individual persistence instead of relying on what they know about modern medical technologies. In future research, however, it will be important to examine the influence of the presumed life status of an animal on attributions of its individual persistence following transformations that alter the object's kind.

3) **Consistency of labels.** In Study 4, we found that the use of a consistent label to refer to an animal both before and after a kind-altering transformation led 5-year-olds to *systematically* judge the object to be the same individual – boosting their performance to be like that of 7-year-olds and adults. In contrast, when we used no labels (in Study 2) or variable labels (in Study 4) to describe an animal before and after a kind-altering transformation, 5-year-olds did *not systematically* judge the object to be the same individual.

Why do consistent labels influence attributions of individual persistence? It is possible that the effect that we observed was simply a response bias to hearing consistent labels used to speak about the objects. In other words, when children heard the same label for any pre- and post-transformation object, they may have overgeneralized the inference

that the objects were the same individual. Our data, however, show that this is not the case. When we used the same count noun to describe the pre- and post-event artifacts, neither children nor adults systematically attributed persistence to the object following kind-altering changes. Instead, our data suggest that the use of same count noun to describe the pre- and the post-event object helped participants to overlook differences in the object's kind/appearance, but only when the kind domain of the object provided a principle of persistence through change (i.e., for animals). These results are consistent with previous research (Gelman & Coley, 1990; Gelman & Markman, 1986; Graham et al., 2012; Waxman & Braun, 2005) that has shown that consistent labels help children to form categories by allowing them to overlook surface differences between objects. Our research extends this prior work by showing that consistent labels also help children to overlook differences in an object's appearance (i.e., its kind) when reasoning about an individual's persistence.

4) **Participants' age.** Finally, there was an age-related change in participants' likelihood of attributing individual persistence to an object following a kind-altering transformation. In particular, early in development, children relied on the persistence of an object's kind for ascriptions of individual persistence for both artifact and animal kinds — that is, children appear initially to be sortalist in their attributions of individual persistence across domains. In the early school years, however, they came to relax their dependence on this constraint, consistent with continuity accounts, but only for animals, and not for artifacts.

How do children overcome their reliance on an animal's persisting kind membership for attributions of individual persistence? First, they may simply need to

encounter the particular types of kind-altering transformations that an animal can undergo (e.g., a caterpillar turning into a butterfly). Our data suggest that children acquire some of this experience between the ages of five and seven. Second, they may need to hear others (e.g., caregivers) describe these events in persistence-supporting ways. For example, when a child watches a tadpole metamorphose into a frog, an adult might say: "This tadpole *turned into* a frog" or "Even though it now looks different, it is still the *same*". These statements presuppose that the individual persists and suggest to the child that it is appropriate to attribute individual persistence to the object following such transformations. Further research will be required to specify the types of experiences that lead to a relaxation of children's reliance on an object's kind to judge its individual persistence.

In conclusion, these four studies contribute to the literature on the representation of individual artifacts (and animals) by showing that people's attributions of individual persistence to objects following change are constrained by several previously unexplored factors. In particular, we observed a change between five and seven years in the criteria guiding judgments of individual persistence through transformation for animals, but not for artifacts – from a dependence on the persistence of an object's kind (consistent with the sortalist account) to an independence from this constraint (consistent with continuity accounts). We also found a significant role for language (i.e., the use of consistent labels) in promoting inferences of individual persistence, especially for animals. These studies therefore help us to understand the complex issue of how people judge whether an artifact (or an animal) remains the same individual over time and through change.

3 The Role of Labels in Attributions of Persistence

3.1 Introduction

When we encounter any artifact in the world, there are many ways in which we can label it. For example, consider the car owned by Batman. To refer to this artifact, we could *name* it using a proper name (e.g., "Batmobile") or we could *describe* it using a noun phrase (e.g., "Batman's car"). Either type of expression may serve to refer unambiguously to an artifact at a particular time, raising the question of whether there are any cognitive implications of choosing one over the other. According to some philosophers, the answer is no: Names are equivalent to and interchangeable with descriptions (e.g., Frege, 1892; Russell, 1905). Yet descriptivist views of proper names have been challenged by many philosophers who have argued that a name is not reducible to a description: According to these non-descriptivist accounts, a name picks out a unique individual, but does not tell us anything about it (e.g., Mill, 1843/1941; see also, Donnellan, 1966, 1972; Kripke, 1980). The current research addresses this longstanding debate by examining the connection between how we label an artifact (using a name or a description) and how we reason about persistence through change.

In the study of lexical development, multiple lines of prior evidence lend support to a non-descriptivist account of proper names. For example, after hearing a novel proper name (e.g., "This is DAX") for an object (e.g., a toy dog), both adults and young children subsequently restrict the label to that particular object, even when it is presented alongside another *identical-looking* object (e.g., Bélanger & Hall, 2006; Hall, 1994, 1996, 2009; Hall, Lee, & Bélanger, 2001; Sorrentino, 2001). These results suggest that from

early in development people assume that a proper name serves to designate an object as a unique individual – not as an instance of a particular kind that satisfies some description. Names, in other words, are not equivalent to descriptions.

Previous research also offers another type of evidence that favors a non-descriptivist view of proper names. A non-descriptivist account of these expressions holds that names serve not only to pick out an object as an individual at a given time, but also to re-identify the same individual over time. In contrast, a description plays the role of (re-) identifying any object/objects that has/have the same property or properties. Hall et al. (2003) found evidence in support of a non-descriptivist understanding of names among preschoolers. In this research, children saw a novel creature that had a particular property (e.g., he was red). The creature underwent a transformation that resulted in the loss of the property (e.g., he became green). When the experimenter labeled the original creature with a proper name (e.g., "This is Mr. Smith"), children extended the expression to the same creature following the transformation, even though its appearance was different. Children did not do so when the experimenter labeled the original creature with an originally true description (e.g., "This is a red one"). Strikingly, when the experimenter labeled the creature with a proper name that contained an originally true description (e.g., "This is Mr. Red"), 4-year-olds extended the expression to the same creature following the transformation even though the description no longer applied (e.g., "Mr. Red" was now green). These findings provide further support for the proposal that names are not equivalent to descriptions.

The current study opens up a new line of investigation into the connection between naming and describing by examining whether the use of a name or a description

to label an artifact influences *how many* objects people include in the expression's extension following change. When we reason about an object's persistence through change, we typically expect that it will remain a single object. Yet artifacts in the world commonly experience transformations – including some puzzling changes in which one object becomes multiple objects over time (e.g., the transformation of artifacts through part replacement and reassembly of the original parts). Philosophers have extensively discussed the implications of these sorts of changes for persistence, with considerable attention focused on the ancient "Ship of Theseus" story (Dauer, 1972; Hirsch, 1982; Hobbes, 1672 /1913; Hume, 1739/2000; Scaltas, 1980, 1981; Smart, 1972, 1973; Wiggins, 2001). In this story, a ship is described as undergoing a gradual and complete part-by-part transformation in which the replacement parts look identical to the original parts. At the end of the transformation, the ship appears unchanged but consists entirely of new parts. At this point, the complete set of original parts is reassembled to create a second identical-looking ship: One object has thus become two.

The Ship-of-Theseus transformation is considered a puzzle because the object (from time 1) ends up being replaced by two objects (at time 2), either of which could be argued to be the same persisting individual. The artifact made entirely of new replacement parts (*new-parts* object) could be judged to be the same individual via a criterion of spatio-temporal continuity of the *whole*: It has followed a connected path that can be traced back to the original object. In contrast, the artifact made entirely of the reassembled original parts (*old-parts* object) could be judged to be the same individual via a criterion of spatio-temporal continuity of the *parts/material*: It contains the same pieces and matter as the original object. Philosophers for years have debated the solution

to this puzzle, with some arguing in favor of the *new-parts* object (Smart, 1972, 1973), others in favor of the *old-parts* object (Dauer, 1972), and still others in favor of either object depending on the interests of the person answering the question (Scaltsas, 1980, 1981; Wiggins, 2001). Given the preceding evidence that the choice of either a name or a description to label an object influences *whether* people extend the expression to the object following change, we hypothesized that this choice would also influence *how many* object(s) people re-identify following a Ship-of-Theseus transformation.

Specifically, we expected that children and adults who heard an object labeled with a name (and, by hypothesis, construed the object as an individual) would re-identify *only one* object following the transformation (either the *old-parts* or the *new-parts* object). In contrast, we expected that those who heard an object labeled with a description (and, by hypothesis, construed the object as an instance of the kind with a particular property/properties) would re-identify *as many* objects as matched the description. The seeming paradox of the Ship-of-Theseus puzzle may therefore stem from whether the puzzle is formulated using a description or a name—with people willing to apply the former to multiple objects but willing to apply the latter to only a single object.

To test our hypothesis, we first developed an adaptation of the Ship-of-Theseus puzzle using toy artifacts. An experimenter presented adults and children with an object (e.g., a truck), stating that she owned it. Half the participants heard it labeled with a proper name (e.g., "This is Tommy"); half heard it labeled with a descriptive noun phrase (e.g., "This is my truck"). While participants watched, the experimenter subjected the artifact to a complete part-by-part transformation and then reassembled the original parts, creating two identical-looking objects. After the transformation/reassembly, the

experimenter asked participants to judge whether the expression they had heard at the outset (e.g., "Is this Tommy?" or "Is this my truck?") applied to each of the post-transformation artifacts. To address whether the type of expression used to label an artifact influences the number of objects people choose following a Ship-of-Theseus transformation, we manipulated how many post-change objects matched the description. Half the participants heard that the experimenter did *not own* the set of replacement parts. For these participants, only the *old-parts* object matched the description (i.e., was composed of parts owned by the experimenter). The other half of the participants heard that the experimenter *did own* the set of replacement parts. For these participants, both post-transformation objects matched the description (i.e., were composed of parts owned by the experimenter).

When the experimenter *did not own* the replacement parts, we predicted that participants would choose only *one* post-transformation object, regardless of whether the original object was labeled with a name or a description: The name would pick out the object as an individual, and the description would match only one object. Additionally, we predicted that participants who heard a name would select the *old-parts* object rather than the *new-parts* object, given previous evidence that children and adults rely on the criterion of spatio-temporal continuity of the parts/material for attributions of persistence to individual artifacts (Hall, 1998). In contrast, when the experimenter *did own* the replacement parts, we predicted that participants' selections would differ depending on how the artifact was labeled. When the object was named, we expected that participants would choose only *one* post-transformation artifact. (Again, we hypothesized that they would choose the *old-parts* object; cf. Hall, 1998.) In contrast, when the object was

described, we expected that participants would choose *both* post-transformation artifacts, because both matched the description (i.e., were composed of parts owned by the experimenter). In this way, the studies provided a novel test of the proposal that names and descriptions are equivalent by examining whether the choice of labeling expression for an object affects reasoning about persistence through change. Study 5 examined adults' responses and Study 6 examined children's responses to this adaptation of the Ship-of-Theseus puzzle. In Studies 7 and 8, we then examined adults' responses to the original version of the Ship-of-Theseus puzzle (Hobbes, 1672/1913).

3.2 Study 5A

3.2.1 Method

3.2.1.1 Participants. Forty-eight English-speaking undergraduates ($M_{\text{age}} = 21.31$ years, $SD = 4.93$ years, 79.17% female) received course credit for participating. They were randomly assigned in equal numbers to the *name-not owned*, *description-not owned*, *name-owned*, or *description-owned* conditions.

3.2.1.2 Materials. There were four sets of stimuli. Each set consisted of a pair of identical toy artifacts (trucks, tables, chairs, airplanes). The artifacts were each composed of three separable parts. We also used four boxes.

3.2.1.3 Procedure. Participants sat at a table in small groups across from the experimenter and provided written answers to all questions. Participants saw four blocks of events, one per stimulus set, presented in a counterbalanced order. In each block, the procedure had four phases.

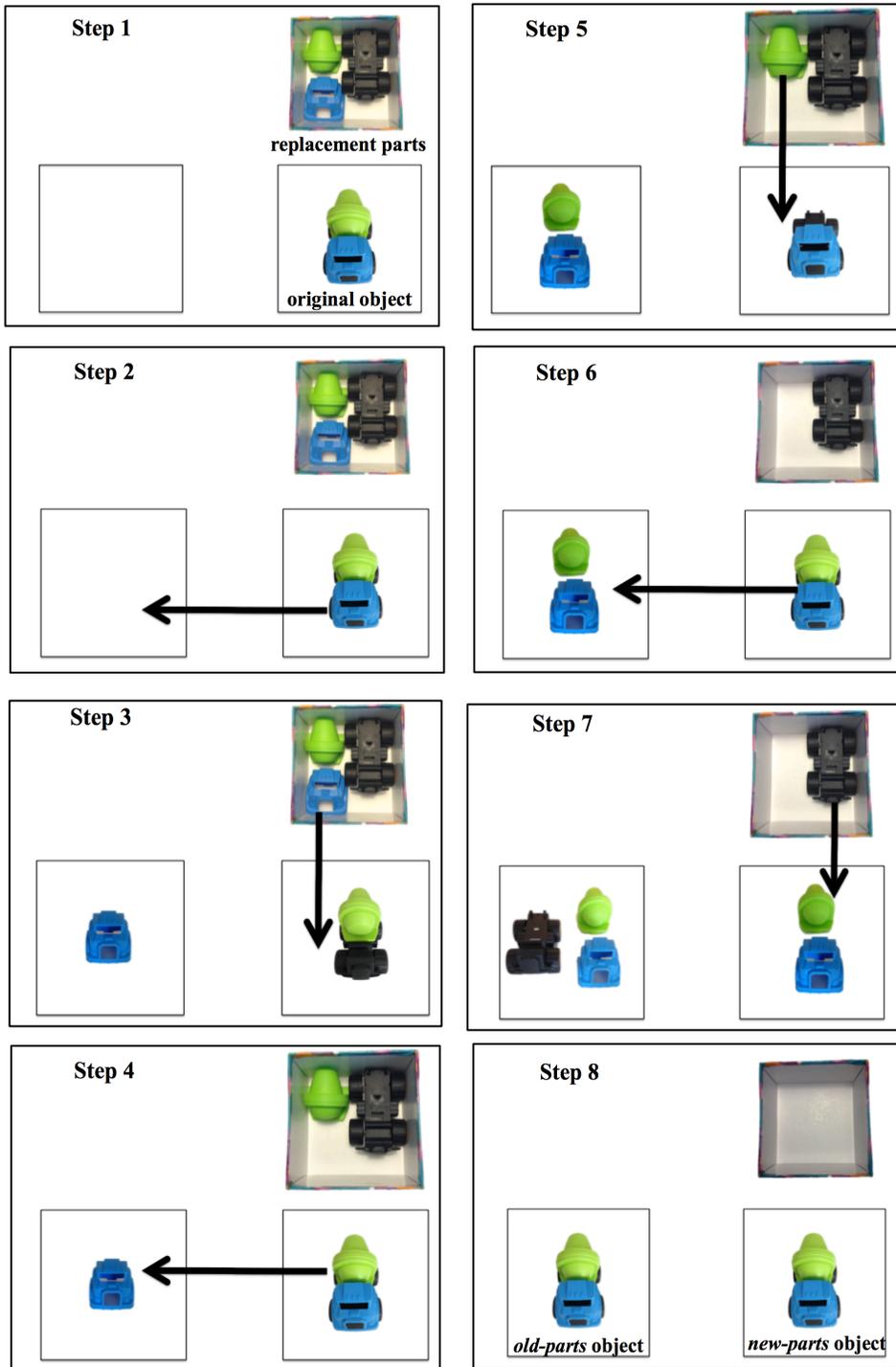
1) Object introduction. The experimenter placed one of the toys from the pair on the right side of the table and labeled the object's kind (e.g., "This is a truck") (see

Appendix B for an example script). She then stated that the object belonged to her. The remainder of the object introduction in each block differed across conditions. In the *name* conditions, the experimenter labeled the object with a familiar proper name (e.g., "This is Tommy"). In the *description* conditions, the experimenter labeled the object with a descriptive noun phrase (e.g., "This is my truck"). In both conditions, participants were then asked to repeat the expression that they had heard. Note that in all conditions it was equally clear that the expression referred to only one artifact.

2) Introduction of replacement parts. The experimenter then brought out a box containing the disassembled set of parts of the other toy in the pair (see Figure 3.1, Step 1). These parts were identical to the parts of the original object. In the *not-owned* conditions, the experimenter stated that the things in the box did *not* belong to her, whereas in the *owned* conditions, she stated that the things in the box did belong to her.

3) Transformation. As participants watched, the experimenter subjected the artifact to a complete part-by-part transformation. The experimenter first removed a part from the original artifact and placed it on the left side of the table (see Figure 3.1, Step 2). She then withdrew the corresponding replacement part from the box and added it to the original object (see Figure 3.1, Step 3). She continued to remove parts from the original object and replace them with their corresponding parts until the object on the right side of the table was made entirely of replacement parts (*new-parts* object) (see Figure 3.1, Steps 4 - 7). The experimenter then reassembled all the original parts to create an artifact made entirely of original parts on the left side of the table (*old-parts* object) (see Figure 3.1, Step 8).

Figure 3.1. Example of Transformation.



4) *Test Trial*. Participants were asked to judge whether the expression they had heard at the outset (e.g., in the *name* condition, "Is this Tommy?" and in the *description* condition, "Is this my truck?") applied to each of the post-transformation artifacts (*old-parts* object and *new-parts* object). (We interpreted the extension of the expression to an object as a marker of persistence.) For half the trials, participants were asked to judge whether the expression applied to the *new-parts* object before the *old-parts* object and for the other half of the trials we reversed the order.

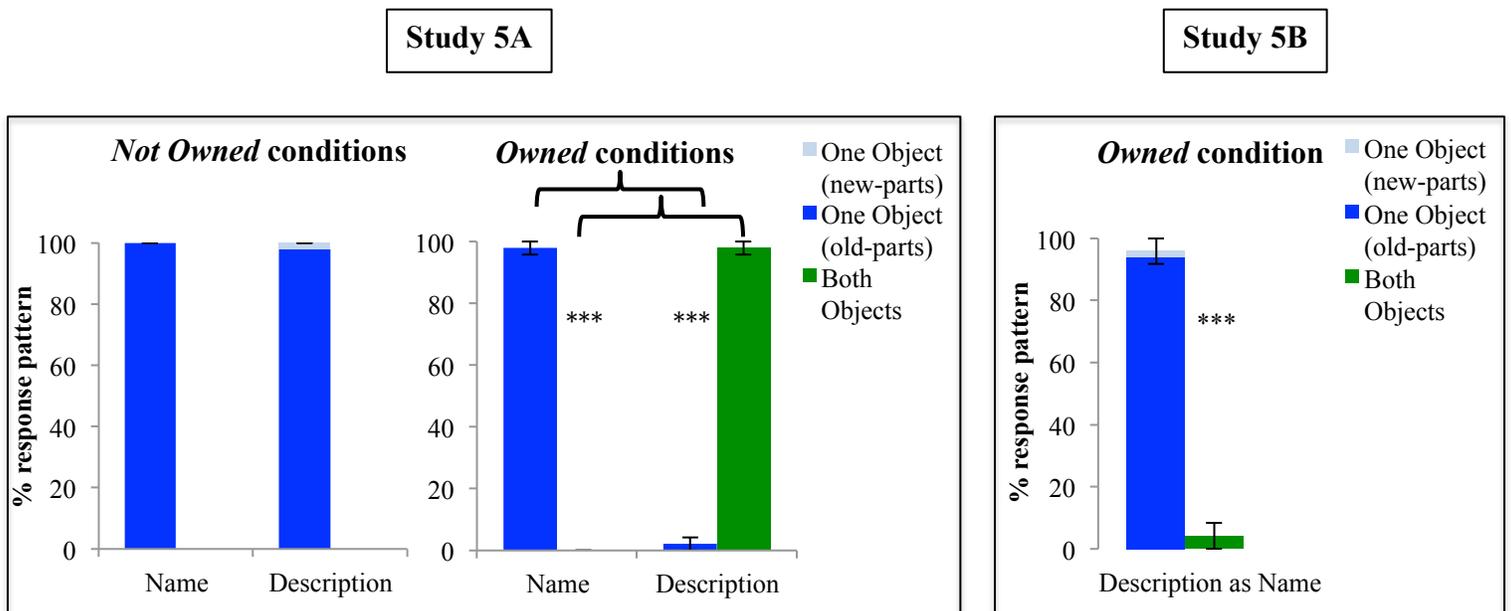
3.2.2 Results and Discussion

To examine *how many* objects participants included in an expression's extension following the transformation, in this and subsequent studies, we coded participants' responses on each test trial based on the pattern of their "yes"/"no" answers to the two questions (i.e., about the *old-parts* object and about the *new-parts* object). We coded their response pattern as "One Object" if they said "yes" to only one object (either the *old-parts* or the *new-parts* object). We coded their response pattern as "Both Objects" if they said "yes" to both the *old-parts* and the *new-parts* objects. Finally, we coded their response pattern as "No Objects" if they said "no" to both objects: This response pattern was very rare (occurring on less than .01% of trials across studies) and will not be included in subsequent analyses.

We next examined whether there were differences in participants' response pattern across the four test trials. There was no effect of trial in this or subsequent studies (based on preliminary ANOVAs, $p > .05$), so we collapsed across this factor. For each participant, we therefore computed a percentage of "One Object" and "Both Objects" response patterns out of a total of four test trials.

Not Owned conditions. In these conditions, recall that *only one* post-transformation object matched the description, because the experimenter did *not* own the replacement parts. Thus, regardless of how an object was labeled (name or description), we expected that participants would select only one post-transformation object. Our results supported this hypothesis. There was no difference between the pattern of responses in the *name* and the *description* conditions (see left panel Figure 3.2). In both conditions, adults showed a "One Object" response pattern following the transformation 100 percent of the time. Furthermore, participants always selected the *old-parts* object in the *name* condition, and they were significantly more likely to select the *old-parts* object than the *new-parts* object in the *description* condition, $t(11) = 23.00, p < .001, d = 6.64$.

Figure 3.2. Adults' Response Patterns in Studies 5A and 5B. Percentage of trials in which adults were coded as showing "One Object" (*new-parts* object in light blue and *old-parts* object in dark blue) or "Both Objects" patterns. Error bars represent one standard error; braces indicate significant differences; *** $p < .001$.



Owned conditions. In these conditions, recall that *both* post-transformation objects matched the description, because the experimenter owned the replacement parts. We expected that there would be a clear difference between adults' patterns of response depending on whether the object was labeled with a name or a description (see left panel Figure 3.2). As predicted, participants were significantly more likely to show a "One Object" pattern in the *name* than in the *description* condition, $t(22) = 32.53, p < .001, d = 13.28$, whereas they were significantly more likely to show a "Both Objects" pattern in the *description* than in the *name* condition, $t(22) = -47.00, p < .001, d = 19.17$.

In the *name* condition, participants were more likely to show a "One Object" pattern than a "Both Objects" pattern, $t(11) = 47.00, p < .001, d = 13.57$. Furthermore, they were significantly more likely to select the *old-parts* object than the *new-parts* object, $t(11) = 47.00, p < .001, d = 13.55$. In contrast, in the *description* condition, participants were more likely to show a "Both Objects" pattern than a "One Object" pattern, $t(11) = -23.00, p < .001, d = 6.64$. When adults showed a "One Object" pattern in this condition, they were equally likely to select the *old-parts* and the *new-parts* objects, $t(11) = 1.00, p > .05, d = 0.29$, but this response pattern was extremely rare.

Our findings reveal an unexplored link between language and cognition: The expression used to label an artifact influences *how many* objects are included in the expression's extension following change. When we used a name to label the original object in our task, adults selected *only one* object following the transformation. In contrast, when we used a description to label the original object, they selected *as many* objects as matched the description. These results suggest that there is a fundamental distinction between names and descriptions: the former pick out individuals, whereas the

latter pick out any objects that have a certain property or properties. Names and descriptions are thus not interchangeable (cf. Frege, 1892; Russell, 1905).

The results also provide insight into the criteria that adults use to judge the persistence of an individual artifact over time. When the object was named (and, by hypothesis, construed as an individual), participants overwhelmingly selected the *old-parts* object, rather than the *new-parts* object. This suggests that adults rely on the criterion of spatio-temporal continuity of the *parts/material*, rather than on the spatio-temporal continuity of the object as a *whole*, for attributions of individual persistence, consistent with previous research based on the Ship-of-Theseus puzzle (Hall, 1998).

3.3 Study 5B

In Study 5A, the expression used to label an object (name or description) influenced *how many* objects adults included in the expression's extension following a transformation. Yet despite the clear difference that we observed between adults' responses in the name and description conditions, it is important to note that names and descriptions have a connected history: Many proper names *originated* as descriptions (Alford, 1987). For example, a number of common English surnames in Medieval times accurately described a person's occupation (e.g., Smith, Baker), place of dwelling (e.g., Woods, Fields), physical features (e.g., White, Small), or parentage (e.g., Johnson for son of John, or Williams for son of William). In Study 5B, we examined whether we could use simple linguistic cues to convert descriptions into names, with implications for persistence judgments in the transformation task from Study 5A. Hall et al. (2003) provided evidence that children can use an expression's surrounding linguistic context to turn a description into a name: Four-year-olds judged an originally true description (e.g.,

"red") presented in the linguistic context of a name (e.g., "This is Mr. Red") to pick out to the same object after change, even when the description no longer applied. In Study 5B, we extended that research by presenting adults with a description in the linguistic context of a name (e.g., "This is *called* X") and examining how many objects they chose following the Ship-of-Theseus transformation from Study 5A.

We presented participants with a transformation based on the *description-owned* condition of Study 5A. However, we now labeled the object with a description presented in the linguistic context of a name (e.g., "This is *called* my truck"). Note that because the experimenter stated that she owned the replacement parts, both post-transformation objects matched the description (i.e., both were composed of parts owned by the experimenter). If the surrounding linguistic context could turn a description into a name, participants should now select *only one* post-transformation object, specifically the *old-parts* object (as in Study 5A): This would suggest that they were treating the expression as a name and, by hypothesis, construing the original object as an individual.

3.3.1 Method

3.3.1.1 Participants. Twelve English-speaking undergraduates ($M_{\text{age}} = 21.08$ years, $SD = 5.25$ years, 75% female) received course credit for participating and were assigned to the *description as name-owned* condition. Four additional adults were tested but not included in the final sample due to experimenter error ($n = 2$) or a failure to repeat the expression they had heard ($n = 2$).

3.3.1.2 Materials. The materials were the same as in Study 5A.

3.3.1.3 Procedure. The procedure was identical to the *description-owned* conditions of Study 5A with only one small difference (see Appendix B for an example

script). During the object introduction, the experimenter labeled the object with a description in the context of a name (e.g., "This is *called* my truck") (see Appendix B for an example script). Note that this wording differs from that of the *description-owned* condition of Study 5A by the addition of a single word (i.e., "*called*"). Following the transformation, participants were asked in counterbalanced order whether the expression they had heard at the outset (e.g., "Is this *called* my truck?") applied to each of the post-transformation artifacts.

3.3.2 Results and Discussion

When adults were presented with a description in the linguistic context of a name, they treated the expression like a name, *not* like a description (see right panel Figure 3.2). Unlike the participants in the *description-owned* condition of Study 5A, participants in the *description as name-owned* condition of Study 5B were more likely to show a "One Object" pattern than a "Both Objects" pattern, $t(11) = 11.00, p < .001, d = 3.18$. Furthermore, they were significantly more likely to select the *old-parts* object than the *new-parts* object, $t(11) = 16.32, p < .001, d = 4.71$.

The results provide evidence that it is possible to turn a description into a name for English-speaking adults using simple linguistic cues. When the word "*called*" was included before a description (e.g., "This is *called* my truck"), participants selected only one object (i.e., the *old-parts* object) following a Ship-of-Theseus transformation. These data stand in sharp contrast to the findings from the *description-owned* condition of Study 5A, in which adults chose both post-transformation objects. Together with the findings from Study 5A, these results highlight the fundamental distinction between names and descriptions.

3.4 Study 6A

In Study 5A, we observed a clear difference between how many objects adults included in an expression's extension following a Ship-of-Theseus transformation when the original object was labeled with a name and when it was labeled with a description. In Study 6A, we examined children's performance on the same task, in order to shed light on the developmental origin of the understanding of the distinction between names and descriptions. Prior research examining children's extensions of names and descriptions to objects has focused on 3- and 4-year-olds (Hall et al., 2003). In that previous work, 3- and 4-year-olds extended a conventional proper name (e.g., "Mr. Smith") to the same object following change, but they did not show the same pattern of extension for an initially true description. Given that the transformations in our study were longer and more complex than those presented in Hall et al. (2003), we focused on slightly older children (5- and 6-year-olds) than in previous work. Prior research has established that children as young as five years can follow object transformations based on the Ship-of-Theseus puzzle (see Hall, 1998).

3.4.1 Method

3.4.1.1 Participants. Eighty English-speaking 5/6-year-olds took part in our study ($M_{\text{age}} = 71.99$ months, $SD = 7.19$ months, 50% female). Participants were randomly assigned to conditions, as in Study 5A. Nine additional participants were tested but not included in the final sample due to parental interference ($n = 2$), a failure to cooperate ($n = 2$), or a failure to repeat the expression they had heard ($n = 5$).

3.4.1.2 Materials. The materials were the same as in Study 5A.

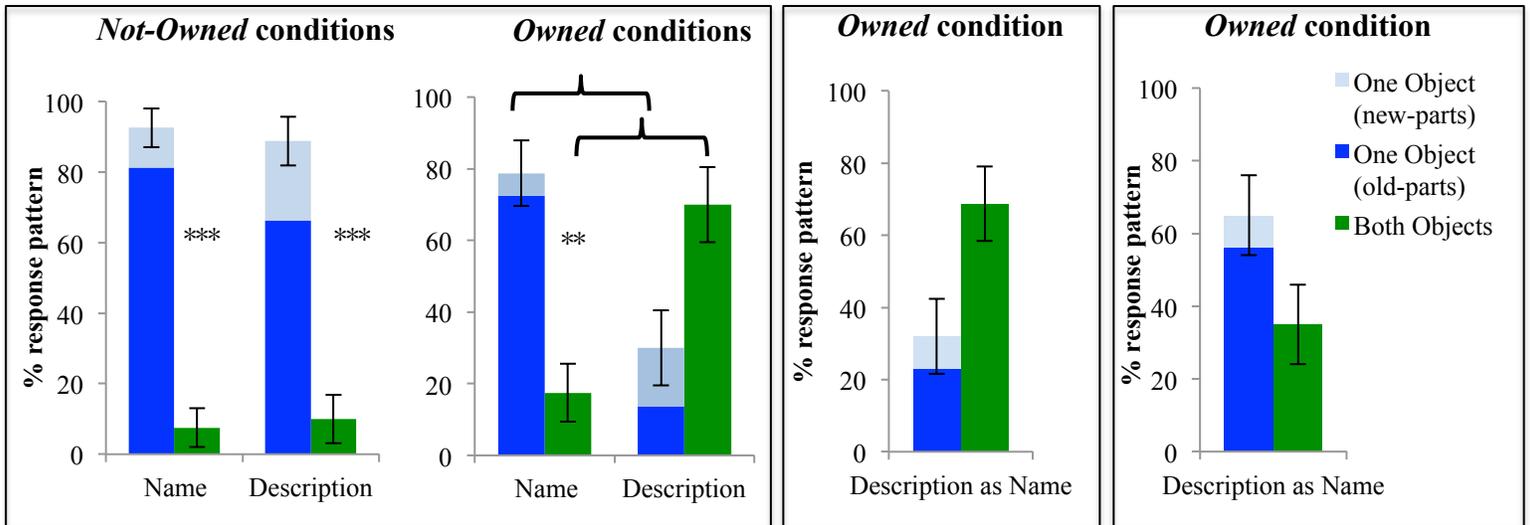
3.4.1.3 Procedure. The procedure was the same as in Study 5A; however, children were tested individually and responded to all questions verbally.

3.4.2 Results and Discussion

Not Owned conditions. As we found with adults, there was no difference between children's response patterns in the *name* and the *description* conditions: Neither independent samples *t*-test was significant, p 's > .05 (see left panel Figure 3.3). Children were significantly more likely to show a "One Object" pattern than a "Both Objects" pattern in both the *name* and the *description* conditions, $t(19) = 7.77, p < .001, d = 1.74$ and $t(19) = 5.74, p < .001, d = 1.28$, respectively. Consistent with adults in Study 5A, children were more likely to select the *old-parts* object than the *new-parts* object in both conditions, $t(19) = 7.09, p < .001, d = 1.59, t(19) = 2.70, p = .01, d = 0.60$, respectively.

Figure 3.3. Children's Response Patterns in Studies 6A, 6B, and 6C. Percentage of trials in which children were coded as showing "One Object" (*new-parts* object in light blue and *old-parts* object in dark blue) or "Both Objects" patterns. Error bars represent one standard error; braces indicate significant differences; ** $p < .01$, *** $p < .001$.

Study 6A
Study 6B
Study 6C



Owned conditions. As with adults, we found a striking difference in children's pattern of responses in the *name* and the *description* conditions (see left panel Figure 3.3). When we compared responses across the two conditions, participants were significantly more likely to show a "One Object" pattern in the *name* than in the *description* condition, $t(38) = 3.50, p < .01, d = 1.11$; whereas they were significantly more likely to show a "Both Objects" pattern in the *description* than in the *name* condition, $t(38) = -3.95, p < .001, d = 1.25$.

In the *name* condition, children were more likely to show a "One Object" pattern than a "Both Objects" pattern following the transformations, $t(19) = 3.63, p < .01, d = 0.81$. Furthermore, they were significantly more likely to select the *old-parts* object than the *new-parts* object, $t(19) = 6.87, p < .001, d = 1.54$. In contrast, in the *description* condition, children were more likely to show a "Both Objects" pattern than a "One Object" pattern, but not significantly so, $t(19) = 1.90, p = .07, d = 0.43$. Like adults, when children did show a "One Object" pattern in this condition, they were equally likely to select the *old-parts* and the *new-parts* objects, $t(19) = 0.25, p > .05, d = 0.06$.

As we found with adults in Study 5A, children were sensitive to the expression used to label an artifact when determining *how many* objects to choose following a Ship-of-Theseus transformation. When the original object was labeled with a name, children selected *only one* post-transformation object. In contrast, when the original object was labeled with a description, they tended to select *as many* post-transformation objects as matched the description; however, this tendency was not as strong as we observed in adults. Moreover, when the object was labeled with a name (and, by hypothesis, construed as an individual), children tended to choose the *old-parts* objects rather than

the *new-parts* objects, consistent with previous research (cf. Hall, 1998). This finding suggests that, like adults in Study 5A, children tended to rely on the spatio-temporal continuity of an artifact's parts/material for attributions of its persistence.

3.5 Study 6B

In Study 6A, the expression used to label an object (name or description) influenced *how many* objects children re-identified following change. As in Study 5B with adults, in Study 6B, we explored whether it was possible to turn a description into a name for young children using simple linguistic cues (e.g., "This is *called* my truck").

3.5.1 Method

3.5.1.1 Participants. Twenty English-speaking 5/6-year-olds ($M_{\text{age}} = 72.00$ months, $SD = 5.86$ months, 50% female) were assigned to the *description as name-owned* condition. Ten additional children were tested but not included in the final sample due to a failure to cooperate ($n = 1$), experimenter error ($n = 1$), or a failure to repeat the expression they had heard ($n = 8$).

3.5.1.2 Materials. The materials were the same as in Study 5A.

3.5.1.3 Procedure. The procedure was the same as Study 5B; however, children were tested individually and responded to all questions verbally.

3.5.2 Results and Discussion

Recall that linguistic cues served to convert a description into a name for adults in Study 5B. In contrast, 5/6-year-olds in Study 6B were not sensitive to these linguistic cues, failing to show the same conversion. Instead, they treated a description presented in the linguistic context of a name like a description (see middle panel Figure 3.3): As in the *description-owned* condition of Study 6A, in the *description as name-owned* condition of

Study 6B, children were more likely to show a "Both Objects" pattern than a "One Object" pattern, although not significantly so, $t(19) = 1.89$, $p = .09$, $d = 0.40$. Also, like in the *description-owned* condition of Study 6A, when children showed a "One Object" pattern, there was no difference in their likelihood of selecting the *old-parts* or the *new-parts* object, $t(19) = 0.25$, $p > .05$, $d = 0.06$.

In contrast to adults, 5/6-year-olds did not appear to use linguistic cues to convert a description into a name. When they heard a description presented in the linguistic context of a name, children tended to re-identify *both* post-transformation objects, suggesting that they were treating the expression as a description that served to pick out any instance of the kind with a particular property/properties. There was also further evidence that children interpreted the expression as a description in their pattern of errors during the administration of the task. In Study 6A, only five percent of children were excluded because they were unable to repeat the expression that they had heard, whereas in Study 6B approximately 25% of children were excluded on these same criteria. When children made an error in Study 6B, it was because they repeated the expression as a description (i.e., when the experimenter said that she *called* the object "my truck", children subsequently stated to the experimenter that the object was "your truck"). Thus, it appeared that they had difficulty overlooking the descriptive content of the expression. Our results therefore indicate that sensitivity to the linguistic contexts that indicate that a description should be interpreted as a name increases between 5/6 years and adulthood.

3.6 Study 6C

In Study 6B, we found that for 5/6-year-olds, the surrounding linguistic context did not serve to convert a description into a name. Instead, when a description was

presented in the context of a name, they tended to re-identify *both* objects following the transformation, consistent with interpreting the expression as a description. To examine when sensitivity to this linguistic cue emerged in childhood, we replicated Study 6B with 7-year-olds.

3.6.1 Method

3.6.1.1 Participants. Twenty English-speaking 7-year-olds ($M_{\text{age}} = 89.05$ months, $SD = 3.25$ months, 50% female) were assigned to the *description as name-owned* condition. Two additional participants were tested but not included in the final sample because of a failure to repeat the expression they had heard.

3.6.1.2 Materials. The materials were the same as Study 5A.

3.6.1.3 Procedure. The procedure was the same as Study 6B.

3.6.2 Results and Discussion

Unlike the 5/6-year-olds in Study 6B, 7-year-olds responded in a similar way to adults in Study 5B (see right panel Figure 3.3). 7-year-olds appeared to use linguistic cues to convert a description into a name. There was no difference between 7-year-olds' responses in the *description as a name-owned* condition of Study 6C and 5/6-year-olds' responses in the *name-owned* condition of Study 6A for both the "One Object" and "Both Objects" patterns, $t(38) = 1.28, p > .05, d = 0.41, t(38) = 0.97, p > .05, d = 0.31$, respectively. However, unlike the *name-owned* condition of Study 6A, when a description was presented in the linguistic context of a name, we found no difference in how often 7-year-olds showed a "One Object" pattern or a "Both Objects" pattern, $t(19) = 1.37, p > .05, d = 0.31$. Like the *name-owned* condition of Study 6A, in contrast, when

participants showed a "One Object" pattern, they were significantly more likely to select the *old-parts* object than the *new-parts* object, $t(19) = 3.57, p < .01, d = 0.80$.

When we labeled the object using a description in the linguistic context of a name (e.g., "This is *called* my truck"), we found that 7-year-olds, unlike 5/6-year-olds, tended to select *only one* object following the transformation, suggesting that they treated the description like a name. These results provide evidence that the sensitivity to the linguistic contexts that indicate that the subsequent expression is a proper name increases between 5/6 and 7 years. However, it also appears that this sensitivity continues to develop, because 7-year-olds did not respond in the same way as adults. They were *not* more likely to attribute persistence to *only one* object following the transformation. Thus, while 7-year-olds were sensitive to this linguistic context, they still appeared to be swayed by the competing cue of the descriptive content of the expression to some extent when determining the extension of the expression. In the General Discussion, we offer an explanation of the age-related change in the sensitivity to this linguistic context.

3.7 Study 7

In Studies 5 and 6, we observed a clear difference in how many objects adults and children included in an expression's extension after they watched an adaptation of the Ship-of-Theseus puzzle and were asked to make judgments of persistence using either a name or a description. In particular, we found that when we used a name to label the original object in our task, participants tended to select *only one* object following the transformation. In contrast, when we used a description to label the original object, they tended to select *as many* objects as matched the description. The results suggest that

people believe that a name picks out an object as individual, whereas a description picks out an object as having a particular property or set of properties.

In light of the results of Studies 5 and 6, it is intriguing to note that in their discussion of the Ship-of-Theseus puzzle, philosophers have differed in the type of expression they have used to label the ship. Some have used a proper name (i.e., rigid designators, such as "X", "C1", etc.) (see Dauer, 1972; Garrett, 1985; Noonan, 1983; Smart, 1972, 1973), while others have used a descriptive noun phrase (e.g., "ship of Theseus" or "Theseus' ship") (see Hobbes, 1672/1913; Hughes, 1997a, 1997b; Scaltas, 1980; Simons, 1997; Wiggins, 2001). Our findings raise the possibility that at least some of the variance in philosophers' previous judgments about the solution to the original version of the Ship-of-Theseus puzzle (Hobbes, 1672/1913) stems from the choice of expression used to label the object. In particular, our findings suggest that the formulation of the puzzle using a name should result in an analysis that favors a single post-transformation object, specifically the *old-parts* object (as in Studies 5 and 6). In contrast, the formulation of the puzzle using a description should result in an analysis that favors either (or both) of the post-transformation objects, depending on the inferences that a person has made about who owns the original parts and who owns the replacement parts. To provide a test of this prediction, we presented adults with Hobbes' (1672/1913) original version of this puzzle and asked them to judge the persistence of each post-transformation object using either a name (i.e., a rigid designator, "X") or a description (i.e., "Theseus' ship").

3.7.1 Method

3.7.1.1 Participants. One hundred and four English-speaking undergraduates ($M_{\text{age}} = 22.14$ years, $SD = 5.13$ years, 83.65% female) received course credit for participating. They were randomly assigned in equal numbers to the *name* or the *description* conditions.

3.7.1.2 Materials. We developed a questionnaire about the original Ship-of-Theseus puzzle using a description of the transformation from Bruce and Barbone's (2011) *Just the Arguments: 100 of the Most Important Arguments in Western Philosophy*. We asked participants to read the following excerpt:

"The "Ship of Theseus" is an intriguing puzzle about identity through time. It is based on the custom of the Athenians to send Theseus' ship [Theseus was the founder king of Athens] each year on a sacred voyage to Delos [the birthplace of Apollo], because it was believed that Apollo once saved the lives of Theseus and his fourteen fellow-travellers. The ritual was annually repeated for a long time, and hence the ship needed continual repair, new planks being substituted for the old ones. Plutarch relates to us that already the Athenian philosophers had discussed whether the ship is still the same ship although it consists, after a while, entirely of new planks. Hobbes put a sophisticated twist to the story: Suppose, he said, that someone collected the old planks and put them together again in the end, thus restoring the old ship. The same ship, then, seems to exist twice [...]"

[I]f, for example, that ship of Theseus, concerning the difference whereof made by continual reparation in taking out the old planks and putting in new, the sophisters of Athens were wont to dispute, were, after all the planks were changed, the same numerical ship it was at the beginning; and if some man had kept the old planks as they were taken out, and by putting them afterwards together in the same order, had again made a ship of them, this, without doubt, had also been the same numerical ship with that which was at the beginning; and so there would have been two ships numerically the same [...]"
(Hobbes, 1672/1913)"

Participants were then asked to rate the identity of both resulting ships on a 6-point scale, from "very sure no" (1) to "very sure yes" (6). In the *name* condition, participants rated the identity of the objects in response to questions phrased using a name (i.e., "Do you think the ship [...] is X?" where "X" referred to the pre-transformation ship). In contrast, in the *description* condition, participants rated the

identity of the objects in response to questions phrased using a descriptive noun phrase (i.e., "Do you think the ship [...] is Theseus' ship?" where "Theseus' ship" referred to the pre-transformation ship). We created two versions of the questionnaire in each condition. In one version, we questioned the *old-parts* object before the *new-parts* object. In the other version, we reversed the order.

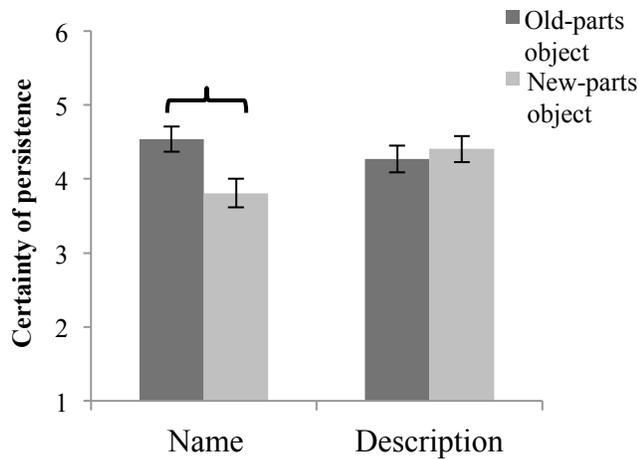
3.7.1.3 Procedure. Participants completed a paper questionnaire individually.

3.7.2 Results and Discussion

A preliminary analysis revealed no difference in judgments between the two versions of the questionnaire (based on paired-samples *t*-tests, all *p*'s > .05 with Bonferroni-Holm correction for multiple comparisons). Thus, we collapsed across versions in the subsequent analysis.

There was a clear difference between adults' patterns of responses depending on whether the object was labeled with a name or a description (see Figure 3.4). Participants in the *name* condition showed a significant asymmetry in their ratings, assigning higher ratings (greater certainty of persistence) to the *old-parts* object than the *new-parts* object, $t(51) = 2.57, p = .01, d = 0.36$. In contrast, participants in the *description* condition gave high and equivalent ratings to both the *old-parts* and the *new-parts* objects, $t(51) = -0.55, p > .05, d = 0.08$.

Figure 3.4. Adults' Ratings of Persistence in Study 7. Error bars represent one standard error; braces indicate significant differences.



In order to examine whether participants systematically judged either of the post-transformation objects to persist, we compared adults' ratings for both the *old-parts* object and the *new-parts* object to the mid-point of the scale (i.e., 3.5). (Ratings above the midpoint provide evidence that participants judged the object to persist.) In the *name* condition, participants' ratings were significantly above the midpoint for the *old-parts* object, but *not* the *new-parts* object, $t(51) = 6.10, p < .001$ [one-tailed], $d = 0.86$, and $t(51) = 1.60, p = .06$ [one-tailed], $d = 0.22$, respectively. In contrast, in the *description* condition, participants' ratings were significantly above the midpoint for both the *old-parts* and the *new-parts* objects, $t(51) = 4.22, p < .001$ [one-tailed], $d = 0.58$, and $t(51) = 5.12, p < .001$ [one-tailed], $d = 0.71$, respectively. Thus, when we used a name to label the ship, adults consistently favored *only one* object following the transformation, whereas when we used a description, they gave equal ratings to *both* objects.

In Study 7, the data were strikingly similar to the results that we observed in Studies 5 and 6 using a stripped-down adaptation of this puzzle. After reading the original Ship-of-Theseus story, adults were sensitive to the expression used to speak

about the artifact when reasoning about persistence. When the ship was labeled with a name, adults provided higher ratings to only one object, specifically the *old-parts* object. In contrast, when the ship was labeled with a description, they provided equal ratings to both objects. The findings are thus consistent with the hypothesis that a name picks out an object as an individual, whereas a description picks it out as an instance of the kind with a particular property/properties.

The data from Study 7 provide evidence that at least some of the variance in philosopher's longstanding debate about the solution to the Ship-of-Theseus puzzle stems from the expression used to label the object. In particular, the findings indicate that a name is more likely than a description to foster intuitions in favor of a single persisting object. Under a description, people tended to judge both of the post-transformation objects to be the "correct" solution to the puzzle. These results are consistent with the possibility that when the object was labeled with a description, people picked out *any* object to which the description could plausibly apply (i.e., any object composed of parts owned by Theseus).

3.8 Study 8

In Study 7, we have proposed that when the object was labeled with a description, participants provided equally high ratings to both post-transformation objects because they believed that both objects matched the description (i.e., both were composed of parts owned by Theseus). While there was no explicit mention of who owned either the original parts or the new replacement parts in the story, we believe that it was plausible to infer from the story that Theseus owned both the old parts and the new parts. Yet because the ownership information was not explicitly provided in Study 7, it remains unclear

whether in fact participants believed that both post-transformation objects matched the description. In Study 8, we tested this possibility by explicitly manipulating whether both post-transformation objects matched the description.

In Study 8, we replicated Study 7, but we now directly asked half the participants to assume that Theseus *owned* both the old original parts and the new replacement parts. For these participants, both post-transformation objects matched the description (i.e., were composed of parts owned by Theseus). In contrast, we asked the other half of the participants to assume that Theseus *did not* own the set of replacement parts. For these participants only the *old-parts* object matched the description (i.e., was composed of parts owned by Theseus). If the results of Study 7 were due to the fact that participants inferred that Theseus owned both the new parts and the old parts, when we explicitly stated that Theseus owned both the old and the new parts in Study 8, we expected to observe the same pattern of results. When the object was labeled with a name, adults should provide higher ratings to only one object, whereas when it was labeled with a description, they should provide equal ratings to both objects. In contrast, when we explicitly stated that Theseus *did not own* the replacement parts, regardless of how an object was labeled (name or description), we expected that participants would provide higher ratings to only one object: The name would pick out the object as an individual, and the description would match only one object.

3.8.1 Method

3.8.1.1 Participants. Two hundred and eight English-speaking undergraduates ($M_{\text{age}} = 20.66$ years, $SD = 3.26$ years, 76.44% female) received course credit for

participating. They were randomly assigned in equal numbers to the *name-not owned*, *description-not owned*, *name-owned*, or *description-owned* conditions.

3.8.1.2 Materials. The materials were the same as those of Study 7, except for one detail. Following the description of the Ship-of-Theseus transformation we provided explicit information about whether Theseus owned the old parts and the new parts. In the *owned* condition, we asked participants to "assume that the old planks that composed the original ship were owned by Theseus and that the new planks that were substituted for the old ones were *also* owned by Theseus." Thus, both the *old-parts* object and the *new-parts* object were composed of planks owned by Theseus. In contrast, in the *not-owned* condition, we asked participants to "assume that the old planks that composed the original ship were owned by Theseus and that the new planks that were substituted for the old ones were *not* owned by Theseus." Thus, only the *old-parts* object was composed of planks owned by Theseus.

3.8.1.3 Procedure. The procedure was the same as in Study 7.

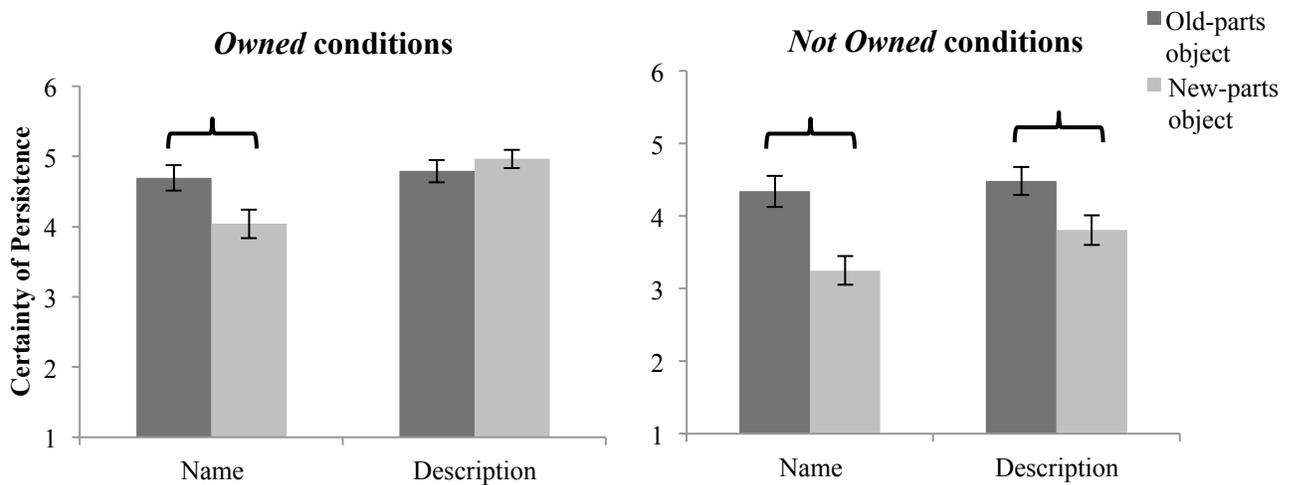
3.8.2 Results and Discussion

As in Study 7, a preliminary analysis revealed no difference in judgments between the two versions of the questionnaire in either condition (based on paired-samples *t*-tests, all *p*'s > .05 with Bonferroni-Holm correction for multiple comparisons). Thus, we collapsed across versions in the subsequent analysis.

We first conducted a repeated-measures analysis of variance (ANOVA) of the ratings with post-transformation object (*old-parts* or *new-parts*) as a within-subjects factor, and ownership (*owned* or *not owned*) and label (*name* or *description*) as between-subjects factors. We observed main effects of object, $F(1, 204) = 13.68, p < .001$,

$\eta_p^2 = .06$, ownership, $F(1, 204) = 34.70$, $p < .001$, $\eta_p^2 = .15$, and label, $F(1, 204) = 15.08$, $p < .001$, $\eta_p^2 = .07$. Additionally, we observed significant two-way interactions between object and ownership, $F(1, 204) = 4.49$, $p = .04$, $\eta_p^2 = .02$, and between object and label, $F(1, 204) = 4.22$, $p = .04$, $\eta_p^2 = .02$. No other interactions were significant. Because we observed a significant interaction involving ownership, we chose to follow up our analysis by examining responses in the *owned* and *not-owned* conditions separately (see Figure 3.5).

Figure 3.5. Adults' Ratings of Persistence in Study 8. Error bars represent one standard error; braces indicate significant differences.



Owned conditions. As predicted, when we stated that Theseus owned both the old parts and the new parts, the pattern of results was essentially the same as in Study 7 (see left panel Figure 3.5). Participants in the *name* condition showed a significant asymmetry in their ratings, assigning higher ratings to the *old-parts* object than the *new-parts* object, $t(51) = 2.07$, $p = .04$, $d = 0.29$. In contrast, participants in the *description* condition gave

high and equivalent ratings to both the *old-parts* and the *new-parts* objects, $t(51) = -0.92$, $p > .05$, $d = 0.13$.

In the *name* condition, unlike in Study 7, participants' ratings were significantly above the midpoint for both the *old-parts* object and *new-parts* object, $t(51) = 6.51$, $p < .001$ [one-tailed], $d = 0.90$, and $t(51) = 2.64$, $p = .01$ [one-tailed], $d = 0.37$, respectively. It appears that, by stating that Theseus owned the replacement parts, we increased adults' willingness to consider the *new-parts* object to be the same individual, even though they still showed an overall preference for the *old-parts* object in their attributions of persistence. We observed the same pattern in the *description* condition as in Study 7. Participants' ratings were significantly above the midpoint for both the *old-parts* and the *new-parts* objects, $t(51) = 8.01$, $p < .001$, $d = 1.11$, and $t(51) = 11.36$, $p < .001$, $d = 1.57$, respectively. As in Study 7, when we used a name to label the ship in Study 8, adults gave higher ratings to the *old-parts* object following the transformation; however, they did not consistently favor only *one* object. In contrast, when we used a description, they gave equal ratings to *both* objects.

Not owned conditions. As predicted, when we stated that Theseus owned *only* the old parts and *not* the new parts, the pattern of results differed from that of Study 7 (see right panel of Figure 3.5). Now participants in both the *name* and the *description* conditions showed significant asymmetries in their ratings, assigning higher ratings to the *old-parts* object than to the *new-parts* object, $t(51) = 3.11$, $p < .01$, $d = 0.43$, $t(51) = 2.02$, $p = .048$, $d = 0.28$, respectively.

Furthermore, in the *name* condition, participants' ratings were significantly above the midpoint for the *old-parts* object, but *not* for the *new-parts* object, $t(51) = 3.95$, $p <$

.001 [one-tailed], $d = 0.55$, and $t(51) = -1.26$, $p > .05$ [one-tailed], $d = 0.18$, respectively. Unlike both the *description* condition of Study 7 and the *description-owned* condition of Study 8, participants' ratings in the *description-not owned* condition were also significantly above the midpoint for the *old-parts*, but not for the *new-parts* objects, $t(51) = 5.08$, $p < .001$ [one-tailed], $d = 0.70$, and $t(51) = 1.50$, $p = .07$ [one-tailed], $d = 0.21$, respectively. In contrast to Study 7, adults in the *not-owned* conditions of Study 8 thus tended to favor *only one* object following the transformation when the object was labeled with a name *or* with a description.

The results of this experiment provide evidence consistent with our hypothesis that people inferred that Theseus owned both the original and the replacement parts in Study 7. When they were asked to solve the puzzle in the *description* condition of Study 7 and in the *description-owned* condition of Study 8, participants judged both post-transformation objects to be included in the expression's extension. In contrast, in the *description-not owned* condition of Study 8, adults tended to include only the *old-parts* object in the expression's extension. Yet in the *name* conditions (in Study 7 and in the *name-owned* and *name-not owned* conditions in Study 8), regardless of who owned the replacement parts, participants provided higher ratings to one object, specifically the *old-parts* object, suggesting that they tended to favor tracking an artifact's individual identity in conjunction with the object's spatio-temporally continuous parts/material, and were willing to overlook a temporary disruption in the object's cohesion during a period of disassembly/reassembly (cf. Hall, 1998). These data therefore strengthen the evidence that names pick out objects as individuals, whereas descriptions pick them out as instances of the kind with a particular property/properties.

3.9 General Discussion

We assessed whether the expression used to label an artifact affects how children and adults reason about persistence following a transformation that resulted in two objects. In particular, we examined whether the choice of a name or a description to label an artifact influenced the number of objects that participants included in the expression's extension following change. When the object was labeled with a name (and, by hypothesis, construed as an individual), children and adults included only one object (usually the object made from the original parts/material) in the expression's extension. In contrast, when the object was labeled with a description (and, by hypothesis, construed as an instance of the kind with a particular property/properties), they tended to include *as many* objects as matched the description in the expression's extension.

We also found evidence that it was possible to turn a description into a name using simple linguistic cues. When adults and 7-year-olds were presented with a description in a linguistic context that indicated that the subsequent expression was a name (i.e., "This is *called* X"), they tended to include only a *single* object (usually the object made from the original parts/material) in the expression's extension following a Ship-of-Theseus transformation. It therefore appears that the linguistic context served to convert a description that picked out *any* instance of the kind with a particular property/properties into a name that picked out an individual. However, there was an age-related change in sensitivity to this linguistic cue. When 5/6-year-olds were presented with a description in this same linguistic context, they tended to include *both* post-transformation artifacts in the expression's extension, suggesting that they did not use this cue to turn a description into a name.

The results of the current studies raise four points for further discussion. First, the data provide new evidence that there is a fundamental psychological distinction between names and descriptions (see also, Hall et al., 2003). People expect a proper name to pick out an object as an individual, whereas they expect a description to pick out an object as an instance of the kind with a particular property/properties. Our findings offer a novel demonstration that children and adults do not represent descriptions and names as interchangeable. These findings are therefore inconsistent with certain descriptivist accounts of proper names that posit that descriptions and names are equivalent (e.g., Frege, 1892; Russell, 1905) and instead provide evidence in support of non-descriptivist accounts (e.g., Mill, 1843/1941; see also, Donnellan, 1966, 1972; Kripke, 1980).

Second, while the data show that there is a clear understanding of the distinction between proper names and descriptions from early in development, there is an age-related change in the reliance on certain linguistic cues that signal whether the subsequent expression is a name. Five/six-year-olds, unlike adults and 7-year-olds, did not use a simple linguistic context (i.e., "This is *called X*") to convert a description into a name. Why might young children fail to make this conversion? One possibility is that 5/6-year-olds do not understand the linguistic contexts (i.e., "*called X*") that indicate that the subsequent expression is a name. We think this possibility is unlikely, however, because prior research has shown that children use these contexts from very early in development to interpret a novel word as a proper name (Hall et al., 2001). Instead, in our task, we hypothesize that when young children were faced with the competing cues of the linguistic context (which suggests that the expression is a name) and the content of the expression (which suggests that it is a description), they gave a heavier weighting to the

content of the expression. It is possible that children weighted the content of the expression more heavily because of the kind of property included in the description: Ownership information is particularly salient for young children (see Blake & Harris, 2011 for a review; see also, Friedman & Neary, 2008; Gelman et al., 2012; Gelman et al., 2014). In contrast, seven-year-olds may be sensitive to the linguistic contexts in our task, because they have an increased ability to inhibit a response that is based on the content of the expression (see Davidson, Amso, Anderson, & Diamond, 2006 for a discussion of the prolonged developmental trajectory of executive functioning).

Third, the data provide insight into the criteria that people use to reason about the persistence of individual artifacts over time. When the original object was labeled with a name (and, by hypothesis, construed as an individual), both adults and children overwhelmingly extended the expression to the object made from the original parts/material following the transformation. People thus overlooked a temporary disruption in the cohesion of an artifact's parts/material through a period of disassembly and subsequent reassembly, but they did *not* judge an artifact to survive the complete replacement of its parts/material (cf. Hall, 1998). While philosophers have debated the solution to the Ship-of-Theseus puzzle for centuries, laypeople (both children and adults) appear to have clear intuitions about how to solve this seeming paradox — when the object is labeled with a name, people rely on the spatio-temporal continuity of the artifact's parts/material to reason about its persistence.

Fourth, the data of Studies 7 and 8 suggest that at least some of the variance in philosophers' previous judgments about the solution to the centuries-old Ship-of-Theseus puzzle stems from the choice of expression used to label the object. Our results show that

using a proper name to refer to the object fosters intuitions in favor of a single persisting object. In contrast, we observed that using a description to label the object allows people to re-identify more than one object, if they infer (in Study 7) or are told (in Study 8) that both post-transformation objects match the description. The data from these studies therefore suggest that if philosophers intend to address questions about individual identity, they should use a name to speak about the object: Only when an object is labeled with a name do people construe it as an individual and make judgments about its persistence as an individual.

At the same time, the data from Studies 7 and 8 show that there remains much unexplained variance in people's judgments about the solution to the original Ship-of-Theseus puzzle, even after accounting for the influence of the expression used to label the object on judgments of persistence. Even when the object was labeled with a name (and, by hypothesis, construed as an individual), participants' ratings for the two post-transformation objects were not categorical. It therefore appears that other factors are also involved in judgments of persistence. It is unclear what these additional factors are, but they may include the inferred duration of the transformation and the assumed history of the object. For example, adults and children may be more likely to favor the object that has followed a spatio-temporally continuous path *as a whole* if they infer that the transformation is carried out gradually over a long period of time rather than a short period of time. Furthermore, participants may be more likely to favor the object that is made of the spatio-temporally continuous *parts/material* if they assume that the initial artifact has an important history than if it lacks one (cf. Dauer, 1972). (See Chapter 4 of this dissertation for an empirical test of this hypothesis.) In future research, it will be

important to examine the influence of these factors on attributions of persistence following the original Ship-of-Theseus puzzle, in an effort to account for further variance in philosophers' judgments about its solution.

In summary, these studies provide evidence from a previously unexamined source that the expression that we use to speak about an artifact influences reasoning about persistence. The findings offer clear new support for the view that names and descriptions are not interchangeable — the former pick out an object as a unique individual, whereas the latter pick it out as an instance of a kind with a particular property/properties. In addition, the data indicate that the longstanding debate among philosophers about the solution to the Ship-of-Theseus puzzle stems (at least in part) from the linguistic expression used to formulate this seeming paradox: When an artifact is labeled with a name (and, thus, construed as an individual), people rely on the criterion of the spatio-temporal continuity of the artifact's parts/material to reason about its persistence.

4 The Role of History in Attributions of Persistence

4.1 Introduction

Although we often fail to treat singular artifacts as important in their own right (e.g., we may judge one fork to be just as good as any other fork to eat with), there are many situations in which we construe artifacts as having a unique individual identity. For example, artifacts can acquire a special importance through a connection to a famous person. By comparing such celebrity-owned artifacts to ordinary artifacts, we can examine the impact of an artifact's history on how people reason about its persistence (both *worth* and individual *identity*) over time and through change. This was the objective of the current study.

A starting point for addressing questions about the role of an artifact's history in reasoning about its persisting worth is the observation that people routinely assign a greater value to artifacts that have been owned by famous individuals than to comparable artifacts without such connections (e.g., John Lennon's piano, John F. Kennedy's desk). This *celebrity effect* is evident in frequent reports of the extravagant prices paid for the personal possessions of well-known public figures (Newman & Bloom, 2014; Newman et al., 2011). The effect has also been documented in the laboratory in adults cross-culturally and also in children using evaluative measures that range from judgments of monetary value to judgments of museum-worthiness (Frazier & Gelman, 2009; Frazier et al., 2009; Gelman et al., 2015; Gjersoe et al., 2014; Hood & Bloom, 2008; Newman & Bloom, 2014; Newman et al., 2011; Newman & Smith, 2016).

The celebrity effect is an example of a more general phenomenon in which people assign an enhanced worth to artifacts that acquire an important history, whether it is through their connection to a famous person (e.g., Jacqueline Onassis' sunglasses), event (e.g., a chair from the Titanic wreckage), or time (e.g., a pot from ancient Greece). Such artifacts have been described as gaining "authenticity" (Frazier et al., 2009) or "historicity" (Hutson, 2012) through such connections. How might these artifacts become imbued with these particular qualities? A number of researchers have proposed that this endowment involves a belief in psychological contagion (e.g., Gelman et al., 2015; Newman & Bloom, 2014; Newman et al., 2011; Rozin & Nemeroff, 1990). Psychological contagion is a widespread form of magical thinking that has been proposed to underlie how people reason about a diverse set of phenomena across many cultures (see Rozin & Nemeroff, 1990 for a review; see also, Hood, Gjerse, Donnelly, Byers, & Itajkura, 2011; Meyer, Leslie, Gelman, & Stilwell, 2013). It involves a belief that an invisible essence (i.e., some property or properties) of a source (often a person) is transferred through contact from the source to a recipient object (Frazer, 1890/1996; Mauss, 1902/1972; Tylor, 1871/1974). It has been hypothesized that it is through their instantiation with this essence that artifacts gain authenticity/historicity and thereby acquire an elevated worth (Gelman et al., 2015; Rozin & Nemeroff, 1990).

Although the existence of the celebrity effect has been widely documented, relatively little is known about the nature of this phenomenon—or about the nature of the psychological contagion posited to underlie it. In particular, it is unclear whether the effect persists in artifacts following any of the myriad transformations they routinely undergo. Unlike living things, artifacts do not experience natural changes brought about

in virtue of the kinds of things they are (i.e., growth, metamorphosis). Yet in everyday life, artifacts do suffer many types of changes. Many experience periods in which they are taken apart and later put back together for ease of transport (e.g., bicycles), cleaning (e.g., pipes) or storage (e.g., tents). Additionally, many endure changes to their constituent parts as they undergo alteration (e.g., suits), repair (e.g., cars), upgrading (e.g., computers) or restoration (e.g., tables). By examining whether the celebrity effect persists following such transformations, we sought to understand people's beliefs about the essence proposed to be transmitted to artifacts in psychological contagion.

Previous research suggests that people believe that the transmission of an essence in psychological contagion requires direct physical contact between a source and a recipient (Nemeroff & Rozin, 2000; Rozin, Millman, & Nemeroff, 1986; Rozin & Nemeroff, 1990, 2002; Rozin, Nemeroff, Wane, & Sherrod, 1989). It remains unclear, however, how people conceive of this essence. One possibility is that people understand psychological contagion to involve a *spreading essence*, reasoning about the transmission of essences as analogous to the transmission of germs (Hutson, 2012; see also, Nemeroff & Rozin, 2000; Rozin & Nemeroff, 1990, 2002). If people understand psychological contagion in this way, they should believe that the essence transferred to the recipient can be passed (after initial contamination) from object parts/material that have had direct contact with the source to subsequently added parts/material that lack such contact. Alternatively, people may understand psychological contagion to involve a *restricted essence* that does not spread (see Nemeroff & Rozin, 1994, on germ vs. residue models of psychological contagion). On this possibility, the essence is conceptualized in the manner of a physical trace deposited on/in the initially contaminated object and restricted to the

parts/material that have had direct physical contact with the celebrity. By examining whether the celebrity effect persists after parts/material changes to artifacts owned by famous individuals, we sought to test between the two accounts of the nature of the essence implicated in psychological contagion.

Philosophers have long debated whether an artifact persists as the same individual through extensive changes to its constituent parts/material (e.g., Hobbes, 1672/1913). In one version of a famous puzzle of identity—the Ship-of-Theseus puzzle—an artifact is described as undergoing a gradual and complete part-by-part transformation in which the replacement parts look identical to the original parts. At the end of the transformation, the artifact appears unchanged but consists entirely of new parts. At this point, the complete set of original parts is reassembled to create a second identical-looking artifact. This puzzle has intrigued philosophers interested in questions of identity because it involves a single pre-transformation artifact that ends up being replaced by two post-transformation artifacts, either of which could be judged to be the same persisting individual as the initial object (e.g., Hirsch, 1982; Hume, 1739/2000; Wiggins, 2001). The artifact made entirely of replacement parts (*new-parts* object) could be judged to be the same persisting individual via a criterion of the spatio-temporal continuity of the object *as a whole*. In contrast, the artifact made entirely of the reassembled original parts (*old-parts* object) could be judged to be the same persisting individual via a criterion of the spatio-temporal continuity of the original *parts/material*.

The preceding puzzle poses a question about the persistence of individual identity that is analogous to our question about the persistence of worth of celebrity-owned artifacts: Does the identity of an artifact spread to subsequently added yet spatio-

temporally connected, replacement parts/material, or does it remain restricted to the object's spatio-temporally continuous original parts/material? Little psychological research has explored how adults reason about the persistence of artifacts through such transformations. One exception is the work of Hall (1998) in which participants received a version of this puzzle involving a simple novel artifact. The results of that research suggest that adults tend to view the identity of artifacts in restricted rather than spreading terms: When asked to choose which of the two post-transformation artifacts was the same individual as the pre-transformation artifact, participants favored the *old-parts* object. Adults thus judged that an artifact persisted through a period of disassembly and subsequent reassembly of its parts, despite the fact that this judgment involved a violation of the spatio-temporal continuity of the object as a whole, a core criterion of object persistence (see Bloom, 2000; Spelke et al., 1995).

In this study, we adapted the preceding puzzle in order to investigate how people reason about the persisting value of celebrity-owned artifacts that suffer changes to their parts/material. Do they judge the enhanced worth ascribed to a celebrity artifact to endure through a spatio-temporally continuous change of its parts/material and/or through its spatio-temporally continuous original parts/material following a period of disassembly and subsequent reassembly? In this way, we aimed to determine whether the psychological contagion posited to underlie the effect involves a belief that a source's essence spreads from an initial recipient object to subsequently added parts/material or remains restricted to the parts/material that have had direct contact with the source at the time of contamination.

In our task, participants read scenarios, each describing an artifact owned by a celebrity or a non-celebrity, and then rated the worth of these objects. Participants next read that each artifact underwent a gradual and complete part-by-part transformation and that the original parts were subsequently reassembled. As in the Ship-of-Theseus puzzle described earlier, each transformation thus resulted in two artifacts: a *new-parts* object and an *old-parts* object. To examine the role of direct celebrity contact in persisting value judgments, we manipulated between conditions whether there was continued contact or no continued contact between the owner and the artifact during the transformation. Participants then rated the worth of both post-transformation artifacts. For purposes of comparison with prior research, we also asked participants to rate the persisting individual identity of the two post-transformation artifacts.

According to both the spreading and the restricted essence accounts of psychological contagion, participants should attribute an enhanced worth to the *old-parts* celebrity artifact, regardless of whether the celebrity maintains contact with the object during the transformation. This enhancement should occur because the celebrity has had direct physical contact with this artifact's parts/material, imparting his/her essence directly to the object. In contrast, the two accounts make different predictions about whether participants should attribute an enhanced worth to the *new-parts* celebrity artifact. According to the spreading essence account, participants should judge the *new-parts* celebrity artifact to have an enhanced worth, regardless of whether the celebrity maintains contact with the object during the transformation: If the celebrity keeps in contact with the artifact, the *new-parts* artifact contains parts/material that have had direct physical contact with the celebrity and should acquire his/her essence directly; and if the

celebrity does not keep in contact with the artifact, the *new-parts* artifact contains parts/material that acquire the celebrity's essence indirectly through its spreading from parts/material that have had direct physical contact with the celebrity (i.e., the original parts) to the new parts/material added to the object. In contrast, according to the restricted essence account, participants should judge the *new-parts* celebrity artifact to have an enhanced worth only if the celebrity maintains contact with the artifact during the transformation: If the celebrity does not keep in contact, his/her essence should not spread to new parts/material added to the artifact.

Finally, in addition to examining the role of celebrity contact in adults' judgments of the persisting *worth* of celebrity artifacts through change, we explored the role of celebrity contact (i.e., the history of an artifact) in judgments of the persisting *identity* of these objects. Recall that in a previous study involving a similar transformation puzzle, Hall (1998) found that most adults chose the *old-parts* artifact to be the same persisting individual as the original, suggesting a restricted view of individual identity. (We also found the same pattern of results in Chapter 3 of this dissertation.) The artifacts in the prior studies were not, however, historically important. In the philosophical literature, there has been discussion of whether the history of an artifact influences judgments of its persistence (Dauer, 1972; Smart 1972,1973). In particular, Dauer (1972) proposed that there is a stronger case to be made that the *old-parts* artifact is the same persisting individual as the original in this puzzle if the initial artifact has an important history than if it lacks one: When the artifact is historically important, its spatio-temporally continuous original parts/material become more central to its persisting identity. If this

proposal is correct, then celebrity contact may affect not only judgments of persisting worth, but also judgments of persisting identity.

4.2 Study 9

4.2.1 Methods

4.2.1.1 Participants. Fifty-three English-speaking North American undergraduate students received either course credit or a two-dollar honorarium for participating ($M_{\text{age}} = 20.5$ years, 87% female). Five participants were excluded from the final sample for reporting that they were unfamiliar with more than one celebrity. The remaining 48 participants were randomly assigned in equal numbers to either the *no continued contact* condition or the *continued contact* condition.

4.2.1.2 Materials. We developed a questionnaire with eight trials, each focused on a different artifact. For four trials, the objects were described as having celebrity owners, whose profession and celebrity status were mentioned explicitly (e.g., Serena Williams, the famous athlete). For the remaining four trials, the owners were described as non-celebrities. These individuals received names with no intended associations to famous individuals and were described as having more mundane professions (e.g., Jennifer Williams, a teacher). Table 4.1 lists the artifacts, the celebrities, the non-celebrities, and their respective professions used in the questionnaires. We selected celebrities that we expected participants to judge favorably, because previous research has revealed a direct relationship between amount of contact with a positively viewed celebrity and an object's value (Newman & Bloom, 2014; Newman et al., 2011)⁵. We also chose artifacts that were associated in some way with the celebrity's profession (and

⁵ In contrast, there is an inverse relationship between amount of contact with an unfavorable celebrity (e.g., Bernie Madoff) and an object's value (Newman & Bloom, 2014; Newman et al., 2011).

thus with the source of their fame) in order to maximize the likelihood that we would observe the celebrity effect in our pre-transformation objects (see Newman et al., 2011).

Table 4. 1 Artifact and Owner Pairs.

Artifact	Celebrity Status	Owner	Profession
Computer	Celebrity	J.K. Rowling	the famous author
	Non-Celebrity	Patricia Johnson	a cashier
Guitar	Celebrity	Taylor Swift	the famous musician
	Non-Celebrity	Mary Wilson	an accountant
Gun	Celebrity	Clint Eastwood	the famous actor
	Non-Celebrity	James Davis	a lawyer
Pen	Celebrity	Stephen King	the famous author
	Non-Celebrity	Michael Jones	a realtor
Piano	Celebrity	Elton John	the famous musician
	Non-Celebrity	John Brown	a salesperson
Soccer Jersey	Celebrity	David Beckham	the famous athlete
	Non-Celebrity	Robert Smith	a server
Tennis Racquet	Celebrity	Serena Williams	the famous athlete
	Non-Celebrity	Jennifer Williams	a teacher
Tennis Shoe	Celebrity	Ellen DeGeneres	the famous comedian
	Non-Celebrity	Linda Miller	a bank teller

We created two versions of each trial, one of which paired a given object with a celebrity (e.g., Serena Williams' tennis racquet) and one of which paired it with a non-celebrity of the same gender (e.g., Jennifer Williams' tennis racquet). As a result, there were two versions of the questionnaire, each of which had a different set of four celebrities and four non-celebrities. Within each version, we created two semi-random orderings of the eight trials, subject to the constraint that one of the versions began with a celebrity trial and one began with a non-celebrity trial.

Each trial consisted of five parts. We describe a sample celebrity trial, involving Serena Williams' tennis racquet:

1) Object introduction. We described the kind of artifact, along with the name and occupation of the owner: "Imagine a tennis racquet. This racquet belongs to Serena Williams, the famous athlete."

2) Pre-transformation worth ratings. Participants provided two ratings of the worth of the initial object: its estimated value and its museum-worthiness (see Frazier et al., 2009). The **value** question was: "How much do you think the particular racquet described in Part 1 would be worth (for example, in an eBay auction)?" Participants answered on a 5-point scale, where 1 was labeled "significantly less than retail price", 3 was labeled "retail price", and 5 was labeled "significantly more than retail price". The **museum** question was: "Do you think the particular racquet described in Part 1 belongs in a museum?" Participants answered on a 6-point scale, where 1 was labeled "very sure it does not belong in a museum", and 6 was labeled "very sure it belongs in a museum".

3) Transformation event. We then described a transformation of the object: "Suppose that the racquet [...] is composed of exactly two hundred and fifty parts. Now suppose that someone finds this racquet in Serena Williams' house". Between conditions, we manipulated whether the owner had continued contact with the object during the transformation. In the *no continued contact* condition, participants read that someone "[...] takes it [the racquet] from the house. Serena never uses the racquet again." In the *continued contact* condition, participants read that someone "[...] leaves it [the racquet] in the house. Serena uses the racquet daily." The remainder of the description was the same for both conditions: "Each month over a period of months, the person removes a single different part. After removing each part, this person puts a new, identical part in its place. This person saves the old parts after each replacement. After all the parts have

been replaced, the person puts together the old parts exactly as they had previously been assembled. This results in two racquets, one made of new parts and one made of old parts. The two racquets look identical. Both racquets are equally functional." We stated that both post-transformation objects looked identical and were equally functional to ensure that participants' ratings of the persisting worth and identity of the two objects were not attributable to differences in their appearance or utility.

4) *Post-transformation worth ratings.* Participants rated both the value and the museum-worthiness of the two post-transformation objects: the *old-parts* object and the *new-parts* object. The questions and scales were the same as those used for the ratings of the pre-transformation objects. In half the questionnaires (of each version), we questioned the *old-parts* object before the *new-parts* object. In the other half, we reversed the order.

5) *Post-transformation identity ratings.* In order to examine the relation between ratings of persisting worth and ratings of persisting individual identity, we asked participants to "suppose that the racquet described in Part 1 [the pre-transformation object] is called 'X'". We then asked them to think of the *old-parts* and *new-parts* objects. We reminded them that both objects looked identical and were equally functional. They were then asked to provide identity ratings for both objects independently by answering whether they thought the object was 'X', using a scale where 1 was labeled "very sure no" and 6 was labeled "very sure yes". In half the questionnaires (of each version), we questioned the *old-parts* object before the *new-parts* object. In the other half, we reversed the order. This order was always the reverse of the order in which we asked the post-transformation worth questions.

At the end of the questionnaire, participants indicated how familiar they were with each celebrity on a 6-point scale from 1 (very unfamiliar) to 6 (very familiar), as well as how favorable they rated each celebrity to be on a 6-point scale from 1 (very unfavorable) to 6 (very favorable). This served as a check that our celebrities were both familiar and perceived as favorable by our participants.

4.2.1.3 Procedure. Participants completed a paper questionnaire individually.

4.2.2 Results

As a check on our manipulation of the celebrity status of the object owners, we first examined participants' ratings of the familiarity and favorability of the celebrities. Participants rated that they were "familiar" ($M = 5.43$, $SD = 0.82$) with all celebrities⁶. In addition, they judged all celebrities to be at least "somewhat favorable" ($M = 4.86$, $SD = 1.02$).

Pre-transformation worth ratings. We next established that participants showed a celebrity effect, rating the worth of the initial celebrity objects more highly than that of the non-celebrity objects.

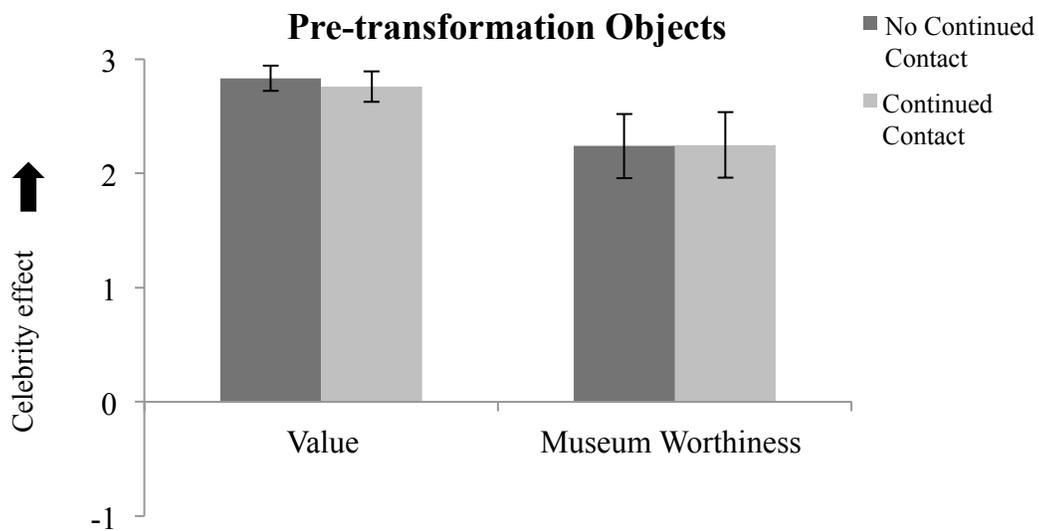
For both the value and the museum questions, we computed a mean rating for each subject for celebrity objects and non-celebrity objects by averaging across the four trials involving each object type⁷. We then computed a mean difference score for each subject for both questions by subtracting the mean rating of the non-celebrity objects from the mean rating of the celebrity objects (see Figure 4.1). These scores could range

⁶ Five participants reported being "somewhat unfamiliar" ($n = 4$) or "unfamiliar" ($n = 1$) with one of the celebrities. While these participants were personally unfamiliar with one of the celebrities, they still judged the celebrity's object to be worth more than retail price. Thus, we included them in the final sample.

⁷ In a preliminary ANOVA, we found no effect of version of the questionnaire on the mean ratings of value and museum-worthiness in either condition. Thus, this factor was not included in subsequent analyses.

from +4 to -4 for ratings of value and +5 to -5 for ratings of museum-worthiness with positive difference scores providing evidence of a celebrity effect.

Figure 4. 1 Pre-Transformation Value and Museum-Worthiness Ratings: Mean Difference Scores. Mean difference scores were computed by subtracting the mean rating of the non-celebrity objects from the mean rating of the celebrity objects. Positive difference scores provide evidence of a celebrity effect. Error bars represent one standard error.

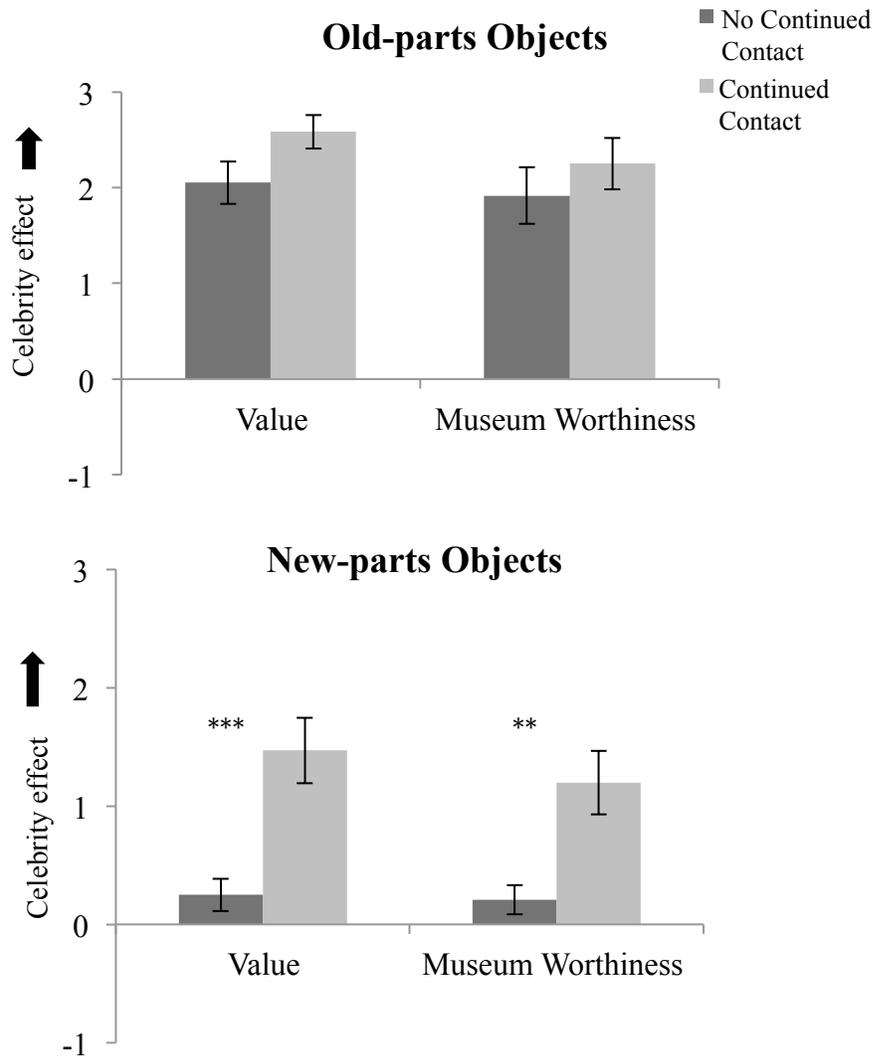


As expected, and consistent with prior results (Frazier & Gelman, 2009; Frazier et al., 2009; Gelman et al., 2015; Gjersoe et al., 2014; Hood & Bloom, 2008; Newman & Bloom, 2014; Newman et al., 2011; Newman & Smith, 2016), an analysis of the difference scores revealed that participants showed a clear celebrity effect on ratings of both value and museum-worthiness in the *no continued contact* and the *continued contact* conditions. One-sample *t*-tests of the mean difference scores against a mean of 0 (the expected mean difference score under the null hypothesis that there is no difference between the ratings of worth for celebrity and non-celebrity objects) were all significant (p 's < .001). In addition, there was no difference in mean difference scores between

conditions on either the value, $t(46) = 0.42, p > .05, d = 0.10$, or the museum-worthiness ratings, $t(46) = -0.03, p > .05, d = 0.01$.

Post-transformation worth ratings. To shed light on how people reason about the persistence of the celebrity effect, we next conducted a parallel set of analyses on the mean difference scores for the two post-transformation objects (see Figure 4.2). We computed difference scores exactly as we did for the pre-transformation objects.

Figure 4. 2 Post-Transformation Value and Museum-Worthiness Ratings: Mean Difference Scores. Mean difference scores were computed by subtracting the mean rating of the non-celebrity objects from the mean rating of the celebrity objects. Positive difference scores provide evidence of a celebrity effect. Error bars represent one standard error; ** $p < .01$; *** $p < .001$.



Old-parts objects. Participants showed the celebrity effect for the *old-parts* artifacts, regardless of whether the celebrity maintained continued contact with the object during the transformation.

The results revealed a clear celebrity effect on ratings of both value and museum-worthiness in the *no continued contact* condition and the *continued contact* condition (see top panel Figure 4.2). One-sample *t*-tests of the mean difference scores against a mean of 0 were all significant (p 's < .001). In addition, there was no significant difference in the mean difference scores between conditions on either the value, $t(46) = -1.88, p > .05, d = 0.44$, or the museum-worthiness ratings, $t(46) = -0.84, p > .05, d = 0.20$.

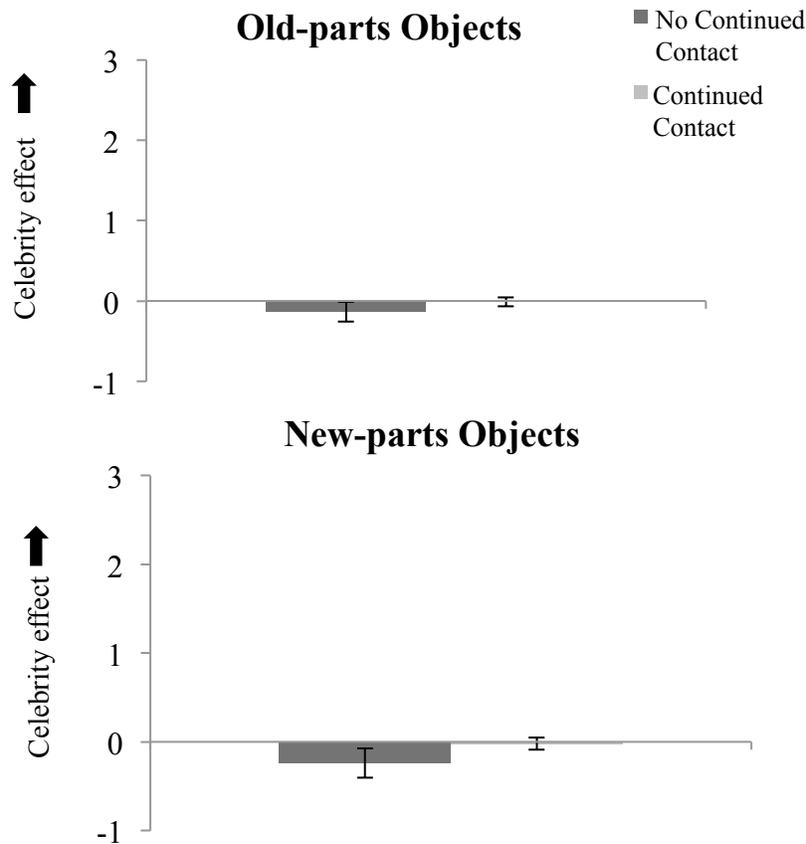
New-parts objects. Participants demonstrated the celebrity effect for the *new-parts* artifacts only if the celebrity maintained continued contact during the transformation. If the celebrity did not maintain this contact, the celebrity effect was not present.

Unlike the pre-transformation objects or the *old-parts* objects, the difference scores for the *new-parts* objects varied between the two conditions (see bottom panel Figure 4.2). We observed a significant difference between mean difference scores in the two conditions on both value, $t(46) = -3.96, p < .001, d = 0.92$, and museum-worthiness ratings, $t(46) = -3.35, p < .01, d = 0.78$. In the *no continued contact* condition, there was no evidence of a celebrity effect for ratings of either value or museum-worthiness (one-sample *t*-tests of the mean difference scores against a mean of 0 were not significant, both p 's > .05). In contrast, in the *continued contact* condition, there was clear evidence of a celebrity effect for ratings of both value and museum-worthiness (both p 's < .001).

Post-transformation identity ratings. Unlike the worth ratings, participants' ratings of the persistence of individual identity were not influenced by the celebrity status of the owner or by whether the owner maintained continued contact with the object during the transformation. For celebrity and non-celebrity artifacts in both conditions, participants ascribed higher persistence ratings to the *old-parts* objects than to the *new-parts* objects.

For identity questions concerning both the *old-parts* and the *new-parts* objects, we computed a mean rating for each subject for celebrity objects and non-celebrity objects by averaging across the four trials involving each type of object. We then computed a mean difference score for each subject, by subtracting the mean rating of the non-celebrity objects from the mean rating of the celebrity objects (see Figure 4.3). These scores could range from +5 to -5 with positive difference scores indicating higher identity persistence ratings for celebrity than non-celebrity objects.

Figure 4. 3 Post-Transformation Identity Ratings: Mean Difference Scores. Mean difference scores were computed by subtracting the mean rating of the non-celebrity objects from the mean rating of the celebrity objects. Error bars represent one standard error.

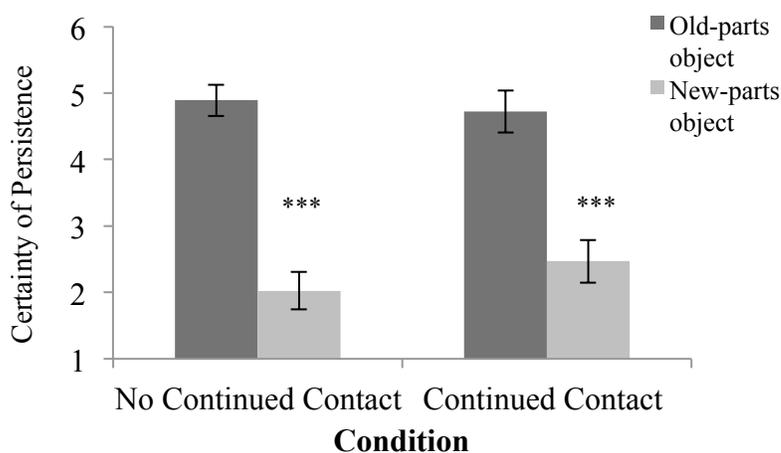


Contrary to Dauer's (1972) proposal, there was no evidence that celebrity contact influenced identity ratings. For the *old-parts* objects, there was no difference between ratings for celebrity and non-celebrity objects in either the *no continued contact* or the *continued contact* condition (one-sample *t*-tests of the mean difference scores against a mean of 0 were not significant, both *p*'s > .05). In addition, there was no significant difference in the mean difference scores between conditions, $t(46) = -0.92, p > .05, d = 0.21$. For the *new-parts* objects, we observed the same pattern of results. There was no difference between ratings for celebrity and non-celebrity objects in either condition

(both p 's $> .05$). There was also no significant difference in the mean difference scores between conditions, $t(46) = -1.21, p > .05, d = 0.28$.

To determine whether participants judged either of the post-transformation objects to be the same persisting individual as the original, we also analyzed the *mean* identity ratings ascribed to the *old-parts* and the *new-parts* objects. Given that there was no difference in identity ratings between celebrity and non-celebrity objects, we collapsed across this factor in these analyses (see Figure 4.4). In both the *no continued contact* condition and the *continued contact* condition, participants were significantly more certain that the *old-parts* object was the same persisting individual than they were that the *new-parts* object was the same persisting individual, $t(23) = 7.69, p < .001, d = 1.57$, and $t(23) = 3.94, p < .001, d = 0.80$, respectively. In addition, there was no difference in the mean identity ratings between conditions for either the *old-parts*, $t(46) = 0.44, p > .05, d = 0.10$, or the *new-parts* objects, $t(46) = -1.11, p > .05, d = 0.26$.

Figure 4.4 Post-Transformation Identity Ratings: Mean Scores. Means were computed by collapsing across celebrity and non-celebrity objects. Error bars represent one standard error. Asterisks indicate a significant difference between ratings for *old-parts* and *new-parts* objects, *** $p < .001$.



4.3 General Discussion

We examined whether people ascribe a heightened worth to celebrity-owned artifacts following transformations of their parts/material. We found that people attributed an elevated worth to these objects only if their parts/material had direct physical contact with the celebrity. In contrast, we did not observe that celebrity contact influenced identity ratings: Adults judged both celebrity artifacts and non-celebrity artifacts to persist through the reassembled spatio-temporally continuous original parts/material. We now discuss the implications of our findings for the nature of psychological contagion, the relationship between persistence of value and persistence of identity, and the preservation of historical artifacts.

Psychological contagion

Insofar as the celebrity effect arises through psychological contagion (e.g., Gelman et al., 2015; Newman & Bloom, 2014; Newman et al., 2011; Rozin & Nemeroff, 1990), our results clarify the nature of the essence that is understood to be transmitted from a source (here a celebrity) to a recipient (here an artifact) in this phenomenon. Specifically, our findings speak against the *spreading essence* account, whereby the essence that is initially embodied in an artifact is understood to be able to propagate in the new parts/material added to the object after its initial contact with the celebrity if the parts/material have no direct contact with the celebrity. In this way, people's understanding of psychological contagion does not appear to be analogous to their understanding of the transmission of disease (cf. Hutson, 2012; Nemeroff & Rozin, 2000; Rozin & Nemeroff, 1990, 2002). Instead, our results are consistent with the *restricted essence* account: People view the essence embodied in a celebrity artifact as confined to

the parts/material of the object that had direct contact with the celebrity, akin to viewing the essence as a residue or trace deposited on or in the parts/material (Nemeroff & Rozin, 1994).

When participants assigned an increased worth to a post-transformation celebrity artifact, we nonetheless observed a drop in value compared to the value ascribed to the pre-transformation object. For the reassembled object made from the *original* parts/material (in both the *no continued contact* and the *continued contact* conditions), this drop may be related to the fact that the object fell temporarily out of existence (during the period of disassembly), resulting in a loss of the strength of the celebrity's essence (i.e., the break-up of the object partially dissipated the trace or residue deposited in/on the parts/material). For the transformed new-parts object (in the *continued contact* condition), the drop may be connected to the fact that the celebrity had less contact with the parts/material of this object (especially the late-added parts/material) than with the parts/material of the pre-transformation object, leading to the belief that the celebrity's essence was more weakly instantiated in this object (i.e., less of a trace or residue was understood to be deposited in/on the object's parts/material). It is also possible that both drops in value are related to the fact that someone other than the celebrity was said to handle the parts/material of the object during the transformation, transferring his/her own essence and diluting the celebrity's essence in/on the artifact.

Our data suggest that psychological contagion involves the transmission of an essence that is restricted to the parts/material that had direct contact with a celebrity owner, but it is an outstanding question just how localized the essence is understood to be. Our study was not designed to examine whether people believe that the enhanced

worth (and, by hypothesis, the celebrity's essence) that is initially transmitted to the recipient artifact is localized to specific individual parts/material of an object that have been in direct physical contact with the owner (e.g., the keyboard of Elton John's piano) or to all parts/material of the object. In future research, it would be interesting to test between these possibilities by asking participants to provide value ratings for parts/material of an object that have received extensive direct physical contact with a celebrity owner (e.g., the keyboard of Elton John's piano) as well as for parts/material that have received limited or no direct physical contact with the celebrity (e.g., the legs of Elton John's piano). If people reason about the heightened worth (and the essence) as being localized to specific parts/material, we would predict the magnitude of enhanced value judgments for parts/material of celebrity objects to vary directly with judgments of the amount of direct physical contact between the celebrity and the parts/material.

Our finding that the celebrity effect arises in conjunction with the object made from the *original parts/material* suggests that the essence instantiated in a celebrity artifact remains embodied in the object for an extended period of time. The transformations in our study were described as occurring each month over a period of 250 months (i.e., approximately 20 years). Participants judged the celebrity objects reassembled from original spatio-temporally connected parts/material to have an enhanced worth even after this period of time, suggesting that people believe the essence that is transmitted to be long lasting. Psychological contagion has often been described with the adage "once in contact, always in contact" (Nemeroff & Rozin, 2000; Rozin & Nemeroff, 1990, 2002). If this adage does capture the nature of the phenomenon, then the length of the transformation should not affect the tendency to assign an enhanced value to

the reassembled celebrity artifact. Although the current results do not shed light on how long the essence can remain instantiated in a celebrity object, we conducted a modified replication of the current study in which we described the same transformations as occurring monthly over a period of only 25 months (i.e., approximately two years). We observed the same results as in the current study, revealing that the celebrity effect did not diminish between two and 20 years. It remains an open question whether people believe the essence to remain instantiated in the object for periods even longer than 20 years (see Frazier et al., 2009, for an examination of people's ratings of the worth of artifacts from ancient times).

As previously mentioned, our study focused on artifacts that were associated in some way with the celebrities' professions, and thus with the source of their fame (e.g., Elton John's piano). Previous research indicates that the celebrity effect also arises in conjunction with objects (e.g., a sweater, a wristwatch, a pair of gloves, or a piece of chewing gum) that are unconnected to a celebrity's profession/source of fame (see Frazier et al., 2009; Gjersoe et al., 2014; Newman et al., 2011; Newman & Smith, 2016). Yet past studies leave open the question of whether psychological contagion is equally strong in association with these sorts of objects. Prior work also does not directly address the question of the amount of direct contact required between a celebrity and an artifact in order for the celebrity effect to emerge. For example, people may judge the piano that Elton John played only once in concert to be more valuable than the toothbrush that he used every day, even though the latter had extensive direct physical contact with the source. Answers to these questions will require further research.

Persistence of value and persistence of identity

Unlike the value ratings, the identity ratings in our study were the same for both celebrity and non-celebrity artifacts. These findings indicate that, although celebrity contact clearly affects how people rate the *persisting worth* of an object following change, it does not influence ratings of an object's *persisting identity*, contrary to Dauer's (1972) proposal. Furthermore, we found that participants rated only one post-transformation artifact, the reassembled original-parts artifact, to be the same persisting individual as the original regardless of whether the celebrity maintained contact with the object during its transformation. These findings replicate the results of Hall (1998) and of Chapter 3 of this dissertation, bolstering the claim that people readily judge artifacts to persist through periods of disassembly and subsequent reassembly, even though such judgments violate a fundamental principle of object cognition: spatio-temporal continuity of the object as a whole (e.g., Bloom, 2000; Spelke et al., 1995). People thus appear to trace the persisting identity of an artifact (celebrity or non-celebrity) through its original spatio-temporally continuous parts/material.

Our results suggest a clear parallel between the way that people reason about the spread of enhanced *value* in a celebrity artifact through change and the way they reason about the spread of individual *identity* through change: They conceive of both in a restricted sense. Participants judged that the heightened value and the identity of a celebrity artifact persisted in its original spatio-temporally continuous parts/material, even through a period of disassembly. At the same time, we observed a clear difference between how people think about the spread of enhanced value and how they think about the spread of identity: If a celebrity maintained contact with an artifact during its

transformation, participants judged *both* the artifact made of the reassembled original parts/material *and* the artifact made of replacement parts/material to have an elevated worth. Yet participants judged *only* the reassembled original-parts artifact to be the same persisting individual, regardless of celebrity contact. This difference suggests an important distinction between criteria for judging the persistence of value and criteria for judging the persistence of identity. When determining whether a transformed artifact carries a heightened value, people rely on whether the object contains parts/material that have been in contact with the celebrity. As a result, people may judge that *multiple* artifacts have an enhanced worth. In contrast, when deciding whether an artifact is the same persisting individual through transformation (e.g., whether a piano is 'X'), people seek out a continuant made of the object's original spatio-temporally continuous parts/material, and only one artifact can satisfy this criterion.

Preserving historical artifacts

These results have implications for practices involved in the preservation of historical artifacts more broadly, not just those owned by celebrities. In particular, our discovery that people ascribe an elevated value to transformed celebrity artifacts only if their new parts/material have had direct physical contact with the famous individual reveals that there is potential economic hazard in restoring historical artifacts by replacing their original parts/material. Making such changes may run the risk of diminishing (if not eliminating all together) the essence imparted to the object and, therefore, any enhancement of the object's value. In contrast, our results suggest there is less risk involved in taking apart a historical artifact for ease of transport, storage or cleaning during restoration. Performing such an action may lower enhanced value ratings

to some degree (as we saw in our own data), but it does not appear to eradicate the heightened worth all together.

Indeed, it appears that people may believe so strongly that a celebrity artifact's heightened value resides in the original parts/material that have had direct contact with the celebrity that they will ascribe a heightened worth to an object made from the original parts/material, even if those parts/material are transformed into an object of an *entirely different kind*. This belief appears to be exhibited by the manufacturer, Croft House, who recently sold sets of speakers made from "historically correct" wood boards from a studio floor once danced upon by Michael Jackson. This manufacturer presumably judged that the heightened value (and, by hypothesis, Michael Jackson's essence) was attached to the original parts/material of the floor and that it would persist even when these parts/material were transformed into objects of another kind. The fact that these speakers sold for an elevated price suggests that the manufacturer's judgment was correct.

Conclusion

Researchers have posited that beliefs in psychological contagion underlie a diverse set of phenomena across many of the world's cultures: The celebrity effect observed in our North American English-speaking sample is just one example. This effect has also been documented in participants outside North America (Frazier et al., 2009; Gjersoe et al., 2014), and analogous effects have been uncovered for a wide range of historically important objects in both Western and non-Western cultural contexts (Frazier & Gelman, 2009; Frazier et al., 2009; Gelman et al., 2015; Gjersoe et al., 2014). Furthermore, psychological contagion beliefs have been invoked to explain a number of other phenomena in various cultural settings, from people's judgments that "you are what

you eat" (Nemeroff & Rozin, 1989), to people's attraction or aversion to clothing worn by others (e.g., Argo, Dahl, & Morales, 2006, 2008), to people's reactions to the consequences of organ transplants (Hood et al., 2011; Meyer et al., 2013). To the extent that our findings elucidate the nature of the essence that is transmitted from a source to a recipient in this form of magical thinking, they may thus contribute to our understanding of a broad set of under-explored issues in human cognition.

In summary, this study provides clear evidence that an artifact's history (i.e., its being owned by a celebrity) influences how people reason about its persisting worth, but *not* its persisting identity, through change. In particular, we found that people believe that any artifact with an important history (i.e., that is composed of parts owned by a celebrity) acquires an enhanced value that persists over time. In contrast, we did not find that an artifact's history influences the criteria used to judge its individual persistence. Regardless of an artifact's connection to a celebrity, adults relied on the maintenance of the object's original spatio-temporally continuous parts/material to judge it to be the same persisting individual, consistent with the results of the studies in Chapter 3 of this dissertation.

5 Conclusion

We are surrounded by artifacts from the moment we are born, and we routinely face the challenge of having not only to identify them but also to (re)-identify them. The nine studies in this dissertation examined the fundamental question of how children and adults represent and reason about individual artifacts through spatiotemporal and qualitative change. In particular, this research explored three issues, pertaining to (1) the role of an artifact's maintained kind membership as a criterion for children's and adults' reasoning about individual persistence, (2) the influence of the expression used to label an artifact on children's and adults' judgments of persistence, and (3) the impact of the history of an artifact on adults' reasoning about its persisting *worth* and persisting individual *identity*.

5.1 Summary of Results and Implications

In Chapter 2 (Studies 1 - 4), we examined the criteria that children and adults use to reason about an artifact's persistence, by focusing on the disputed issue of whether attributions of individual persistence for an artifact depend on the persistence of the object's kind membership (see Blok et al., 2007a, 2007b; Rhemtulla & Xu, 2007a, 2007b; Rips et al., 2006; Xu, 2007). We presented adults, 5-year-olds, and 7-year-olds with stories involving transformations of artifacts (and animals, as a point of comparison) and asked them to judge the persistence of the objects following the events. When the transformation was kind preserving, children and adults judged that both artifacts and animals remained the same individuals, regardless of the cause of the change.

When the transformation was kind altering, however, there was a striking difference in patterns of responses across ages: Five-year-olds did *not* systematically

judge an artifact (or an animal) to be the same individual, regardless of the transformation's cause. They showed a reliance on the object's persisting kind membership for attributions of individual persistence across domains, consistent with the sortalist account. Yet 5-year-olds overcame their reliance on an object's kind when we used a consistent label to describe the pre- and the post-transformation object for animals, but not for artifacts. In contrast, adults and 7-year-olds judged animals, but did *not* systematically judge artifacts, to be the same individuals following these events, regardless of the transformation's cause. Adults were, nevertheless, more likely to ascribe persistence to artifacts after transformations with domain-appropriate causes (i.e., external) than after transformations with causes that were *not* domain appropriate (i.e., spontaneous). The results show that the way that people represent and reason about individuals changes over the course of development, with children loosening their reliance on an object's kind maintenance for attributions of individual persistence, but only if the kind domain of the object provides a principle of persistence through change (i.e., for animals).

In Chapter 3 (Studies 5 – 8), we observed a striking influence of the expression (proper name or description) used to label an artifact on judgments of persistence. Using an adapted version of the Ship-of-Theseus puzzle, in Studies 5 and 6, we presented 5- to 7-year-olds and adults with a toy artifact that the experimenter subjected to a gradual and complete part-by-part transformation, followed by the reassembly of original parts/material to create a second identical object. This transformation is considered a puzzle because the object (from time 1) ends up being replaced by two objects (at time 2), either of which could be considered the same persisting individual. The object made

of new replacement parts could be judged to be the same individual via a criterion of spatio-temporal continuity of the object *as a whole*. In contrast, the object made of the reassembled original parts could be judged to be the same individual via a criterion of the spatio-temporal continuity of the *parts/material*. When the object was labeled with a name, children and adults tended to extend the expression to *only one* object (in particular, the object made from the original *parts/material*) following the transformation. When the object was labeled with a description, however, participants tended to extend the expression to *as many* objects as matched the description. The results indicate that adults and children understand a fundamental distinction between proper names and descriptions: A proper names picks out an object as an individual, whereas a description picks it out as an instance of the kind with a particular property (or properties). The findings provide evidence of a previously unexamined way in which language influences cognition — how we label an artifact influences how children and adults reason about persistence.

Furthermore, in Studies 7 and 8, we observed the same pattern of results in adults' judgments of persistence after they read the original version of the Ship-of-Theseus puzzle (see Hobbes, 1672/1913). When adults were asked to solve this puzzle using a name, they assigned higher ratings (associated with greater certainty of persistence) to the object made from the original spatio-temporally continuous *parts/material* than to the object that followed a spatio-temporally continuous path *as a whole*. In contrast, when participants were asked to solve the puzzle using a description, they gave high and equivalent ratings to both post-transformations artifacts when the description could plausibly apply to either object. These results suggest that that at least some of the

variance in philosopher's judgments about the solution to the Ship-of-Theseus puzzle stems from the choice of expression used to label the ship.

Finally, in Chapter 4 (Study 9), we examined the role of an artifact's history (i.e., its being owned by a celebrity) on ascriptions of its persisting *worth* and individual *identity* following Ship-of-Theseus transformations. We found that adults ascribed a heightened worth to celebrity-owned artifacts following these transformations only if their parts/material had direct physical contact with the celebrity. Insofar as the celebrity effect (i.e., the fact that people assign a greater value to artifacts owned by celebrities than to comparable artifacts without such connections) arises from psychological contagion, the findings suggest that the essence imparted to a celebrity-owned artifact is conceived as akin to a residue deposited in/on the object rather than a germ capable of spreading in an indirect manner to new parts/material added to the object. Unlike the value ratings, however, participants' judgments of individual persistence in our study were the same for celebrity and non-celebrity artifacts. These findings indicate that although celebrity contact clearly affects how people judge the *persisting worth* of an object following change, it does not influence judgments of an object's *persisting identity*.

5.1.1 Criteria that Guide Attributions of Individual Persistence

The data from the current studies provide insight into the criteria that children and adults use to guide their attributions of individual persistence to artifacts. In particular, we observed that children's and adults' attributions relied on two criteria: an object's maintained kind membership and the continuity of an artifact's original parts/material through change. In this way, the data shed light on the nature of people's concepts of individual artifacts.

First, in Studies 1 to 4, there was evidence that people relied on an artifact's persisting kind membership for attributions of its individual persistence, consistent with the sortalist account (Hirsch, 1982; Macnamara, 1986; Wiggins, 2001; Xu, 2007). It is perhaps unsurprising that people rely on an artifact's kind for attributions of its individual persistence, because of the nature of the representations of artifact kinds. As previously discussed, people believe that members of artifact kinds possess a shallow essence that is related to the creator's intended function (see Keil, 1989; Kelemen & Carey, 2007), whereas they believe that members of animal kinds have a deep essence (e.g., DNA or some other internal property; see Gelman, 2003). Children and adults may therefore *not* systematically judge an artifact to persist as the same individual following kind-altering changes because they believe that an artifact's shallow essence does not provide a principle of persistence through change. In contrast, they may systematically judge an animal to persist as the same individual following such changes because they believe that an animal's deep essence provides such a principle.

Furthermore, people may rely on an artifact's maintained kind membership for attributions of individual persistence because of the nature of the transformations that artifacts can undergo. To gain insight into the nature of artifact transformations, it is first important to consider the types of changes that animals experience. In particular, there is a principled connection between an animal's kind and the types of changes that it can undergo (see Hirsch, 1982). For example, a caterpillar, by virtue of being a caterpillar, can become a butterfly. In comparison, artifacts do not experience these same types of changes. Instead, artifacts can undergo transformations that occur either by virtue of the material from which they are made (e.g., a metal car, by virtue of being made of metal,

can rust) or through external intervention (e.g., a car, by virtue of a person's intervention, can become dented) (see Hirsch, 1982). In other words, there is *not* a principled connection between an artifact's kind and the changes that it can undergo. For instance, it is *not* that a table, by virtue of being a table, can become a chair. Thus, when an artifact's kind is changed through external intervention, children and adults appear *not* to have clear intuitions about whether the object persists as the same individual, likely because their representations of artifacts do not include information about the principled types of kind-altering changes that they can undergo.

Second, in Studies 5 to 9, we observed that children and adults relied on the spatio-temporal continuity of an artifact's *part/material* for ascriptions of its individual persistence (cf. Hall, 1998). While the spatio-temporal continuity of an artifact's *parts/material* and its spatio-temporal continuity *as a whole* are related in most situations (i.e., when an artifact does not experience change), we examined the independent influence of these levels of spatio-temporal continuity by presenting participants with transformations based on the Ship-of-Theseus puzzle. Following these transformations, when participants were asked to make attributions of individual persistence (under a name), both children and adults tended to select *only* the object that was made of the original spatio-temporally continuous parts/material and *not* the object that had followed a spatio-temporally connected path as a whole. We thus found that people overlooked a *temporary* disruption in the cohesion of the artifact's parts/material – so long as the post-transformation artifact was made of the original parts/material. These judgments thus involved a surprising violation of our fundamental understanding of physical objects – in particular, the core criterion that objects are cohesive *as a whole* over time (Spelke, 1990,

2000). Yet by the early school years, children come to override some of our most basic knowledge of objects in order to reason about the persistence of artifacts through change. Moreover, the data also provide novel insight into how children and adults solve the longstanding Ship-of-Theseus puzzle (cf. Hirsch, 1982; Hobbes, 1672 /1913; Hume, 1739/2000; Wiggins, 2001), a question that philosophers have contemplated for centuries.

5.1.2 The Role of Labels in Attributions of Persistence

The results of Studies 5 to 8 demonstrated that the expression that we use to label an artifact has a potent impact on reasoning about persistence. In particular, we found evidence that names and descriptions are not interchangeable — children and adults believe that the former pick out an object as a unique individual, whereas they believe that the latter pick it out as an instance of the kind with a particular property/properties. The results show that people do not represent an individual simply as a collection of its properties. The data are inconsistent with certain descriptivist accounts of proper names that posit that descriptions and names are the same (e.g., Frege, 1892; Russell, 1905) and instead provide evidence in support of non-descriptivist accounts (e.g., Mill, 1843/1941; see also Donnellan, 1966, 1972; Kripke, 1980). The findings in our studies thus address a longstanding debate in the philosophical literature about the relationship between names and descriptions.

Furthermore, the data shed light on one possible reason for the enduring debate among philosophers about the solution to the Ship-of-Theseus puzzle (Dauer, 1972; Hirsch, 1982; Hobbes, 1672 /1913; Hume, 1739/2000; Scaltas, 1980, 1981; Smart, 1972, 1973; Wiggins, 2001). When we presented adults with the original version of the Ship-of-

Theseus puzzle we found that using a name to refer to the original object tended to foster intuitions in favor of only a single persisting object. In contrast, when we asked participants to solve the puzzle using a description, they tended to judge both of the post-transformation objects to be the "correct" solution (i.e., a ship composed of parts that are owned by Theseus), if they inferred/or were told that both objects matched the description. The data from these studies provide compelling evidence that at least some of the variance in philosopher's judgments about the solution to the Ship-of-Theseus puzzle stems from the expression used to label the object. Therefore, in future research about this puzzle, if philosophers intend to address questions about an artifact's persisting *individual* identity, it would be prudent to formulate the story using a name (e.g., "Which of the resulting objects is "X"?") to ensure that people construe the ship as an individual and consequently make judgments about its persistence as an individual.

Finally, the results of these experiments suggest that the way that we speak about an artifact may have important implications in property disputes. Imagine, for example, that Theseus bequeathed his ship to one of his heirs by stating in his will that: "I leave *my ship* to my heir". If the object had undergone a Ship-of-Theseus transformation during the course of Theseus' lifetime (with a second ship having been reconstructed from the original parts), it would be difficult to determine (under a description) which ship Theseus intended to leave to his family member. In this situation, Theseus' heir could rightfully lay claim to either (or potentially both) objects, because they both match the description (i.e., are ships composed of planks owned by Theseus). It is therefore important to be aware of the ambiguity inherent in using a description to refer to an artifact, especially in situations in which there are legal consequences of the decision.

5.1.3 The Role of History in Attributions of Persistence

In Study 9, we observed that an artifact's history (i.e., its being owned by a celebrity) influenced judgments of its persisting worth following change, but it did not influence attributions of its individual persistence, demonstrating that this type of social information influences some, but not all, elements of our representations of artifacts. This difference suggests an important distinction between criteria for judging the persistence of *value* and criteria for judging the persistence of *identity*. When determining whether a transformed artifact carries a heightened value, people rely on whether the object contains parts/material that have been in contact with the celebrity. As a result, people may judge that *multiple* artifacts have an enhanced worth. In contrast, when deciding whether an artifact is the same persisting individual through transformation (e.g., whether an artifact is 'X'), people seek out a continuant made of the object's original parts/material, and only one artifact can satisfy this criterion.

Furthermore, our results address philosophers' debate about whether the criteria used to ascribe individual persistence to an object depend on its history (Dauer, 1972; Smart 1972, 1973). We observed that adults' attributions of individual persistence were the same for historically important artifacts (i.e., those owned by a celebrity) and artifacts that lacked such a history (i.e., those owned by a non-celebrity). Regardless of an object's history, people's attributions of individual persistence depended on the spatio-temporal continuity of the artifact's parts/material, suggesting that this criterion guides how adults re-identify *all* artifacts following change.

5.2 Future Directions

5.2.1 Attributions of Persistence for Different Kinds of Objects

This dissertation focused on how children and adults reason about the persistence of individual artifacts. As previously discussed, however, reasoning about artifacts differs from reasoning about other kinds of things in the world (see Gelman, 2003, for a review; see also, Keil, 1989). In Studies 1 to 4, we observed a domain difference in children's and adults' attributions of individual persistence to artifacts and animals following kind-altering transformations. In future research, it will be important to examine how people reason about the persistence of other kinds of objects. One particular area of interest is how children and adults reason about the persistence of people over time and through change. For instance, do attributions of individual persistence for a person depend on his/her remaining the same kind of thing (e.g., a member of the same social group)? Furthermore, does the label used to refer to a person (proper name or description) influence attributions of his/her persistence following change?

5.2.2 Neural Correlates of Attributions of Persistence

In this dissertation, all experiments involved behavioral measures (i.e., verbal or written responses from participants). In particular, we asked children and adults whether the same proper name applied to an artifact following a transformation in order to measure whether they judged the object to persist as the same individual. In our studies, we focused on young school-aged children and adults because participants needed to have the necessary linguistic capacity to comprehend and respond to questions verbally. By using neuroimaging techniques, however, it would be possible to present the same types of transformations to infants and toddlers. These techniques would allow us to

examine whether infants and young children judge an individual artifact to persist following the types of transformations that we examined in this dissertation without requiring a verbal response.

In future research, we could address the developmental origin of the ability to reason about an artifact's individual persistence through spatiotemporal and qualitative change using electroencephalography (EEG). Previous research has identified EEG components that are correlated with persisting object representations (Csibra & Johnson, 2007; Kaufman, Csibra, & Johnson, 2003, 2005; Tallon-Baudry & Bertrand, 1999). For example, in prior research, Kaufman et al. (2005) examined gamma-frequency oscillations measured by event-related oscillations over the right temporal cortex in 6-month-olds following two types of object disappearances: one that involved a persisting object (i.e., occlusion) and another that did *not* involve a persisting object (i.e., disintegration). In this study, Kaufman et al. found that gamma frequency increased when the object was occluded, but not when it disintegrated, suggesting that increases in gamma frequency may be a signature of the maintenance of a persisting object representation. We could therefore use this methodology to compare whether participants of different ages reason about transformations as involving a persisting object (i.e., whether there is an increase in gamma frequency). The use of neuroimaging techniques would allow us to shed light on whether there are changes in people's attributions of individual persistence to artifacts over the course of development.

Furthermore, given that we observed a difference between how people reason about the persistence of an artifact labeled with a name or a description, it would be important to know whether this distinction is coded in the brain. Previous research has

shown that processing of proper names and count nouns occurs in different parts of the brain (see Semenza, 2009, for a review). Evidence for this claim, however, has come primarily from a double dissociation observed in patients with neurological damage: Some patients have deficits in the production of proper names, but not count nouns (Semenza, Mondini, Borgo, Pasini, & Sgaramella, 2003), whereas other patients have deficits in the production of count nouns, but not proper names (Martins & Farrajota, 2007). In future research, we could extend these prior studies by examining whether the processing of proper names and descriptions (i.e., noun phrases) also occurs in different parts of the brain of healthy children and adults. If we observe a difference, this data would provide additional evidence in support of non-descriptivist accounts of proper names that posit that descriptions and names are *not* equivalent (e.g., Mill, 1843/1941; see also, Donnellan, 1966, 1972; Kripke, 1980).

5.3 Concluding Statement

Philosophers have long raised questions about how people re-identify individual artifacts following displacements and qualitative change. These fundamental issues, however, have received limited attention in the psychological literature. The studies in this dissertation used the methods of cognitive science to address these venerable questions. In particular, we found evidence that both children's and adults' concepts of individual artifacts (labeled with a name) include the requirement that the object must remain the same kind of thing following change in order to be judged to be the same individual. Furthermore, the data showed that an artifact's original parts play a privileged role in children's and adults' representations of its persisting identity, regardless of its history. This research therefore not only makes an important new contribution to the

psychological literature on children's and adults' concepts of individual artifacts, but also shows that it is possible to acquire empirical answers to some of philosophy's most longstanding problems.

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Appendix A

Example Script: Studies 1 - 2

Example Animal Event Script

1) Object introduction. Look what I have here. This is a caterpillar. Look at the caterpillar. This is a caterpillar. Now can you tell me, what is this? (*Adult provides written response or child provides verbal response.*)

And do you know what? This caterpillar is called Annie. Do you see? This is Annie. Isn't it cool that I call this caterpillar, Annie? What is this caterpillar called? (*Adult provides written response or child provides verbal response.*)

2) Transformation event. Look! This is a room. This room is empty. There is nothing in this room. One day, I put this caterpillar called Annie in the room and then I closed the door. I went away for many weeks.

While I was away, nobody came to the room because it was locked up tight. Nobody touched what was in the room for many weeks. When I came back to the room, I opened the door. Look what I saw. Remember that nobody came to the room while I was away.

3) Test event: Study 1. Now I have a question for you. Is this a caterpillar? (*Adult provides written response or child provides verbal response.*)

Test event: Study 2. Now I have a question for you. Is this Annie? (*Adult provides written response or child provides verbal response.*)

Example Artifact Event Script

1) Object introduction. Look what I have here. This is a chair. Look at the chair. This is a chair. Now can you tell me, what is this? (*Adult provides written response or child provides verbal response.*)

And do you know what? This chair is called Charlie. Do you see? This is Charlie. Isn't it cool that I call this chair, Charlie? What is this chair called? (*Adult provides written response or child provides verbal response.*)

2) Transformation event. Look! This is a room. This room is empty. There is nothing in this room. One day, I put this chair called Charlie in the room and then I closed the door. I went away for many weeks.

While I was away, somebody came to the room because it was left unlocked. This person worked on what was in the room for many weeks. When I came back to the room, I opened the door. Look what I saw. Remember that somebody came to the room while I was away.

3) Test event: Study 1. Now I have a question for you. Is this a chair? (*Adult provides written response or child provides verbal response.*)

Test event: Study 2. Now I have a question for you. Is this Charlie? (*Adult provides written response or child provides verbal response.*)

Appendix B

Example Script: Studies 5 - 6

1) Object introduction. Now look what I have here. This is a truck. Look at the truck. This is a truck. Do you know what? This truck belongs to me.

Name conditions. This is Tommy. Do you see? This is Tommy. Isn't it cool that I call this truck, Tommy? What is this truck called? (*Adult provides written response or child provides verbal response.*)

Description conditions. This is my truck. Do you see? This is my truck. Isn't it cool that this is my truck? Whose truck is this? (*Adult provides written response or child provides verbal response.*)

Description as name condition. This is called "my truck". Do you see? This is named "my truck". Isn't it cool that I call this "my truck"? What is this truck called? (*Adult provides written response or child provides verbal response.*)

2) Introduction of replacement parts. And look here.

Not-owned conditions. This box has things that don't belong to me. Do you see? The things in this box don't belong to me.

Owned conditions. This box has things that belong to me. Do you see? The things in this box belong to me.

3) Transformation. Now watch what I am doing. Do you see what I am doing? Wow! Did you see what I did? I moved all the parts that were here (*experimenter points to the right hand side of the table*) over to here (*experimenter points to the left hand side of the table*).

4) Test Trial. Now I have some questions for you.

Name conditions. (*Experimenter points to one of the two post-transformation objects.*) Is this Tommy? (*Adult provides written response or child provides verbal response.*)

(*Experimenter points to the other post-transformation object.*) Is this Tommy?
(*Adult provides written response or child provides verbal response.*)

Description conditions. (*Experimenter points to one of the two post-transformation objects.*) Is this my truck? (*Adult provides written response or child provides verbal response.*)

(*Experimenter points to the other post-transformation object.*) Is this my truck?
(*Adult provides written response or child provides verbal response.*)

Description as name condition. (*Experimenter points to one of the two post-transformation objects.*) Is this called "my truck"? *Adult provides written response or child provides verbal response.*

(*Experimenter points to the other post-transformation object.*) Is this called "my truck"? (*Adult provides written response or child provides verbal response.*)