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Adults are intuitive mind-body dualists

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### Abstract

In the present research, we tested the hypotheses that (1) adults are intuitive mind-body dualists, (2) that this belief can be considered a default, and (3) that it is partially explained by essentialistic reasoning about the nature of the mind. Over eight studies, employing various thought experiment paradigms, participants reliably ascribed to a physically duplicated being a greater retention of physical than of mental properties. This difference was unrelated to whether or not this being was given a proper name (Study 1b) and was only found for entities that were considered to actually possess a mind (Study 1c). Further, we found that an intuitive belief in mind-body dualism may in fact be considered a default: Taxing participants' cognitive resources (Study 2) or priming them with an intuitive (vs. analytical) thinking style (Studies 3a & 3b) both increased dualistic beliefs. In a last set of studies, we found that beliefs in mind-body dualism are indeed related to essentialistic reasoning about the mind. When a living being was reassembled from its original molecules rather than recreated from new molecules, dualistic beliefs were significantly reduced (Studies 4a & 4b). Thus, results of the present research indicate that, despite any acquired scientific knowledge about the neurological origins of mental life, most adults remain "essentialistic mind-body dualists" at heart.

Keywords: common-sense beliefs; naïve theories; mind-body dualism; thought experiments; essentialism

## Introduction

In the 2006 Hollywood movie *The Prestige* (Nolan, 2006), the protagonist—a struggling magician in the 1920s—devised the ultimate illusion: The transported man! On stage, the magician is strapped to a futuristic-looking device, and upon the pull of a lever is shrouded by fog and lightning. In the blink of an eye he disappears, only to reveal himself on a balcony opposite of the stage. He seems to have been magically transported. Yet, unbeknownst to the astounded audience, something entirely different took place. Instead of carrying out an instant transportation, the device created a 100% perfect duplicate of the magician in an elsewhere located second unit, while the “original” magician fell through a trapdoor and drowned in a water tank below the stage. The duplicate then proceeds to reap the rewards of his feat. Thus, the magician willingly dies every night so that his doppelgänger (or *himself*) can continue with the show, without ever having any recollection of dying. The viewer is now left with an interesting variation of Derek Parfit’s (1984) famous “teleportation” thought experiment and the question: Is the duplicate person still the *same* person as the original? What if the original magician somehow survived, which of the two would then be *him*?

Most of us intuitively find these questions difficult to answer. People have the natural tendency to perceive themselves, others, and even non-living entities to possess certain immeasurable qualities, or essences, that are not described by physical properties and that ultimately define who or what they are (e.g., Gelman, 2003; Medin & Ortony, 1989; Newman & Keil, 2008; Gottfried, Gelman, & Shultz, 1999). This belief, referred to as *essentialism*, helps to explain why, for example, the intention of a creator plays an important role for us in the assessment of his or her creation (Newman & Bloom, 2012), or why we believe that even mundane objects can “transmit” negative personality traits (Nemeroff & Rozin, 2000). When it comes to human beings, thinking in terms of essences can have even more striking effects,

which may be the reason for why we are unsure about whether the duplicate magician remains the same magician. We are inclined to believe that humans possess one unique immeasurable quality, sometimes labeled a soul, a mind, or a spirit, that cannot be copied by a machine or simulated by a computer. In our intuition, this essence is the home of our thoughts, emotions and personal identity, and effectively makes us what we are. Based on our phenomenological experience, we perceive our bodies and this essence to be two separable, yet somehow interacting, entities—a notion referred to as Cartesian *mind-body dualism* (Descartes, 1641/1984). In other words, we do not perceive ourselves to be a bundle of firing neurons, but rather, as if we occupy our physical body, using it to navigate the material world (Bloom, 2004; Boyer, 2001; Forstmann, Burgmer, & Mussweiler, 2012; cf., the *Cartesian theater*, Dennet, 1991).

Such lay beliefs in mind-body dualism can be found in virtually all human cultures (Chudek, McNamara, Birch, Bloom, & Heinrich, 2013; Roazzi, Nyhof, & Johnson, 2013; Cohen, 2007) and seem to be one of the prerequisites for the development of more elaborate supernatural beliefs, such as in a life after death, in reincarnation, or ghosts (e.g., Bering, 2006; Bloom, 2007). All these beliefs require an individual to entertain the notion that mental states can somehow survive the death of a physical body and therefore rely on endorsing the view that mental life is not fully explained by physical processes.

But one does not need to resort to religious scripture or philosophical teachings to find examples of mind-body dualism. Pop culture is riddled with tales of juveniles waking up in bodies of adults, adults waking up in the bodies of giant beetles, or minds of serial-killers being trapped in children's toys. All these scenarios share a dualistic view of minds and bodies, as a physical transformation occurs without a logically required change of mental states. But even in the absence of actual human beings does a belief in the independent nature of mind and body affect our understanding of the social world. For example, it may allow us

to ascribe mental processes—such as rational thought or intentionality—to factually non-living entities, and thus perceive minds where there logically should not be any (cf. Gray, Gray, & Wegner, 2007; Epley, Waytz, & Cacioppo, 2007). Although we know that, for example, shoes usually do not possess a central nervous system, a TV commercial involving a thinking and talking shoe would not strike us as mind-bending or utterly confusing. We all readily comprehend the concept of a mind that is independent from a physical body and that exists in the absence of a brain. But why is this the case, and why is this phenomenon so culturally ubiquitous?

As some researchers argue, the perceived separation of mind and body that defines mind-body dualism is rooted in our most fundamental cognitive architecture (Bloom, 2004; Bering, 2006), which seems to be predisposed to differentially process social and non-social stimuli (Kuhlmeier, Bloom, & Wynn, 2004; Legerstee, 1992). We have the natural tendency to attribute goals to agents, interpret their behaviors as means to reach these goals, and thereby make inferences about mental processes that we cannot directly perceive with any of our senses (Gergely, Nádasdy, Csibra, & Bíró, 1995). This often-called “theory of mind” (Wellman, Cross, & Watson, 2001)—our ability to take others’ perspectives and infer their mental states—is believed to constitute an evolutionary-acquired skill, necessary to accurately predict the behavior of others, that ultimately enables the formation of dualistic beliefs (Povinelli & Bering, 2002). That is, it fosters the development of two different modes of construal, one dealing with the physical, the other with the social world. Following this logic, beliefs in mind-body dualism can be considered a “by-product” of our cognitive architecture, which is tuned to distinguish between observable bodies and unobservable mental processes (Bloom, 2004; Saxe & Kanwisher, 2003). In line with this reasoning, recent findings suggest a close interlink between explicit beliefs in mind-body dualism and cognitive processes that

emerge from our ability to acknowledge other people's mental states—in particular conceptual and spatial perspective-taking (Burgmer, Forstmann, Todd, & Mussweiler, 2014).

Given this basic-cognitive nature of dualistic beliefs, it is reasonable to assume that they can be considered a “default belief” that all humans rudimentary share from early on in their lives. In fact, past research in developmental psychology strongly hints at this notion (e.g., Johnson & Wellman, 1982). For example, children who were told a story about an anthropomorphized mouse that was eaten by an alligator subsequently ascribed more continuing emotional (e.g., fear) than physical states (e.g., hunger) to the dead mouse that lingers in the afterlife (Bering & Bjorklund, 2004; but see also Astuti & Harris, 2008). Even more recently, Hood and colleagues (2012) found further evidence for mind-body dualism in pre-school children. Children of that certain age believed that “magically” duplicating a physical entity—in this case a live hamster—does not duplicate mental states associated with the original to the same extent as physical states. At this developmental stage, children seem to understand that people need a brain for remembering facts or doing calculus, but they regard it as a tool that they *themselves* use to execute these operations. In their perception, their brain is not responsible for their identity or for phenomenological experiences such as pretending to be a kangaroo or loving one's siblings (Bloom, 2004; Lillard, 1996). The knowledge that everything humans experience can be entirely understood as a function of brain activity, corresponding to the philosophical position referred to as *physicalism*, seems to be acquired in later developmental stages through education and enculturation (Choe, Keil, & Bloom, 2012; Johnson, 1990).

As a result, when explicitly asked about their conceptions about the relation of minds and bodies, most adults in Western societies deny that both are entirely independent entities (Procter, 2008) and have a slight tendency to agree with strictly physicalistic rather than dualistic statements (Hook & Farah, 2013). However, as research has shown that naïve

theories can easily co-exist with acquired scientific knowledge (Shtulman & Valcarcel, 2012), an explicit endorsement of physicalistic beliefs cannot rule out that people remain intuitive mind-body dualists at heart.

### **The Present Research**

The present research aimed at providing initial evidence for this proposition. Thereby, our goal was to further the understanding of the nature of dualistic beliefs as well as their underlying processes. More precisely, the goals of the present research were threefold: First, adapting a paradigm designed by Hood and colleagues (2012), we set out to develop a reliable measure for intuitive mind-body dualism in adults, consequently showing that such beliefs are still prevalent in developmental stages that extend beyond early childhood (Studies 1a—1c). Second, we tested the hypothesis that beliefs in mind-body dualism can in fact be considered a default that most people intuitively share. If that was the case, taking up a physicalistic (i.e., non-dualistic) stance would require the use of cognitive resources to correct for our initial (dualistic) intuition. Therefore, we tested whether taxing participants cognitive resources (Study 2) or priming them with an intuitive (vs. deliberative) thinking-style (Studies 3a & 3b) would increase intuitive mind-body dualism. Third, in line with the previously discussed reasoning, we sought to find initial support for the proposition that dualistic beliefs are grounded in essentialistic beliefs about the nature of the mind. To that end, we tested, whether dualistic beliefs are intimately linked to a belief in invisible and undetectable properties of matter that turn any entity into something that supersedes the sum of its parts (Studies 4a & 4b).

### **Study 1a**



In the first study, our goal was to develop a new measure for intuitive mind-body dualism in adults, based on an experimental paradigm previously employed by Hood and colleagues (2012), and to show that intuitive dualistic beliefs are still prevalent among adults. In the original study, 5-6 year-old children were introduced to a scientific looking machine (cf., Hood & Bloom, 2008)—complete with flashing lights and buzzers—and were told that this machine was able to duplicate any object placed inside one of its adjacent boxes. Subsequently, children were introduced to a live hamster, and were told about some of the hamster’s unique physical attributes, namely a blue heart, a broken tooth, and a marble in his stomach. They were further asked to show the hamster a picture, whisper their names into his ear, and tickle him in the back, thereby creating novel mental states in the hamster in form of episodic memory. After successfully “duplicating” the hamster (with the help of a hidden experimenter, an identical looking second hamster, and some sleight of hand), the children were asked about physical and mental attributes of both the original and the duplicate. Ruling out several alternative explanations, the authors were able to demonstrate that children reliably attributed to a duplicate hamster the original’s physical properties to a greater extent than the original’s mental states. In line with previous findings in developmental psychology (e.g., Bering & Bjorklund, 2004), this divergence can be considered an early manifestation of an intuitive belief in mind-body dualism.

In adapting this paradigm for adults, we modified it on a few critical dimensions. Instead of involving a live demonstration, the measure was constructed as a text-based thought experiment with a more scientific framing than the original paradigm. We hypothesized that—regardless of any explicit religious belief or knowledge about the physical origins of the mind—adults would intuitively dissociate minds and bodies the same way children did in the original study.

## **Method**

**Participants and design.** Ninety-eight participants<sup>1</sup> recruited from Amazon’s Mechanical Turk website (62 females,  $M_{Age} = 37.50$ ,  $SD = 13.09$ ) participated in exchange for monetary compensation. Each participant worked on the thought experiment task described below.

**Materials and procedure.** In this thought experiment, participants were asked to imagine a future in which scientists developed a device, which allows them to “duplicate any kind of object in a matter of seconds using highly-advanced technology. After placing an object into a small chamber, a computer scans the entire object (i.e., the entire content of the chamber), every molecule and every single atom, and stores the information digitally. The information is then used to recreate the scanned object in a second chamber from basic chemical elements, molecule for molecule, resulting in a 100% identical copy of the scanned object, with a 100% success rate” (see Supplementary Materials). Emphasis was put on the fact that the duplicate was 100% identical to the original, as well as to the 100% success rate of the procedure, in order to prevent participants from questioning the accuracy or reliability of the device. The whole procedure was further explained by a picture, detailing the functionality of the device. Participants were subsequently told that “— after some successful trials with solid objects—the scientists place the lab hamster Jimmy into the first chamber and duplicate it.”

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<sup>1</sup> Sample-sizes for Studies 1a, 1b, 1c, 4a, and 4b are based on broad a-priori estimates of effect sizes. Sample size for Study 3a was determined by responses to an open call for participation posted to a mailing list. For Study 3b the goal was to collect as many participants as possible in the time in which lab space was available. Sample size for Study 2 was based on the original study by Conway and Gawronski (2012). Odd numbers in sample sizes for online studies were caused by random assignment of participants to different experiments. All exclusions of participants are mentioned in-text.

Next, participants learned about 12 properties of Jimmy, 6 of which were physical and 6 of which were mental in nature, presented in a fixed random order (see Table 1). For example, they learned that Jimmy has a limp (*physical*) and is afraid of the cruel lab intern (*mental*). The different physical and mental attributes were carefully designed to capture different aspects of each dimension. Physical attributes contained states that were innate (Jimmy has a dark spot in his fur), acquired and stable (Jimmy has a scar on his back), or acquired and temporary (Jimmy currently has the flu). Two items were designed to be more “complex” in nature, and included one item that directly pertains to the brain—the actual source of mental states—and one item that pertains to the eye, one of the more complex organs in human and non-human animals and furthermore the place where a considerable number of people locate the “self” of a being (Starmans & Bloom, 2012).

Mental attributes were designed to represent affective (Jimmy feels at home in the lab), basic-cognitive (Jimmy reacts to his name being called), and memory-related (Jimmy vividly remembers his sister) states.

Participants then learned that “[o]nly one second later, the process is completed and a 100% perfect duplicate of Jimmy—for reference named “Bert”—emerges in the second chamber.” They were subsequently asked to indicate on 7-point Likert-type scales ranging from *definitely no* over *undecided* to *definitely yes*, how each physical and mental attribute (still) applies to each hamster. Asking not only about the duplicate but also about the original hamster allows to control for the fact that participants may have thought the duplication procedure somehow altered physical or mental attributes of the original, thereby making it impossible to correctly interpret the results obtained for the duplicate (cf. Hood et al., 2012).

For each hamster, scores for the six physical properties (original:  $\alpha = .83$ , duplicate:  $\alpha = .79$ ), as well as scores for the six mental attributes (original:  $\alpha = .80$ , duplicate:  $\alpha = .95$ ) were combined to form indices representing ascribed retention of physical and mental

attributes. If people do intuitively separate minds from bodies, differences in ascribed mental properties between original and duplicate should be greater than differences in ascribed physical properties.

{TABLE 1}

## Results and Discussion

No participants were excluded from data analysis.

*Factor Analysis.* We conducted a principle axis factor analysis with oblim rotation on the 12 items pertaining to the duplicate hamster<sup>2</sup>. Two factors emerged with eigenvalues greater than 1 (5.70 and 2.28, respectively), collectively accounting for 67% of the variance in responses. As hypothesized, all six items intended to describe *mental* attributes loaded stronger on factor 1 than on factor 2, and were overall the items with the strongest loading on factor 1. Conversely, the remaining six items intended to describe *physical* attributes loaded stronger on factor 2 than on factor 1, and were also overall the items with the strongest loading on this factor. The two isolated factors (extracted by regression) were significantly positively correlated with one another ( $r = .40, p < .001$ ), suggesting that both factors are tapping related (i.e., general accuracy of the device), yet distinct (i.e., mental vs. physical properties) constructs.

*Main Analysis.* For the main analysis, we expected to observe a greater difference in ascriptions of mental properties to both hamsters than in ascriptions of physical properties. A two-way repeated measures ANOVA over all four indices revealed the proposed hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental) interaction,  $F(1, 97) = 107.7, p <$

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<sup>2</sup> Responses pertaining to the original hamster did not vary sufficiently enough to allow conducting a meaningful factor analysis.

.001,  $\eta_p^2 = .56$ . More precisely, a paired-samples  $t$ -test revealed that differences in the ascription of mental properties between original and duplicate ( $M = 2.85$ ,  $SD = 1.96$ ) were indeed greater than differences in the ascription of physical properties ( $M = 0.93$ ,  $SD = 1.39$ ),  $t(97) = 10.39$ ,  $p < .001$ ,  $d = 1.08^3$ . Analyzing responses to the individual hamsters, we found no difference in the ascription of retained physical versus mental properties for the *original* hamster ( $p > .25$ ), whereas participants ascribed to the *duplicate* hamster a greater retention of physical properties ( $M = 5.77$ ,  $SD = 1.30$ ) than of mental properties ( $M = 3.91$ ,  $SD = 1.88$ ),  $t(97) = 10.31$ ,  $p < .001$ ,  $d = 1.09$ ; see Figure 1.

In line with the previously discussed findings by Hood and colleagues (2012), this dissociation seems to indicate that people intuitively do perceive mental states to be partly independent from physical properties and thus assume a physical copy of a living being has mental states that differ from the original. They therefore seem to be intuitive mind-body dualists.

{FIGURE 1}

However, similarly in line with Hood and colleagues (2012), participants ascribed to the duplicate hamster a significantly lesser degree of retained *physical* properties as compared to the original, although instructions clearly stated that the device created a “100% identical copy of the original with a 100% success rate”. One reason for this effect could be that participants questioned the accuracy of the duplication device described. As a result, one could argue that participants believed small inaccuracies in the physical duplication procedure to have more striking effects on mental than on physical properties of the duplicate. We

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<sup>3</sup>All within-subject Cohen’s  $d$  effect sizes were corrected for dependence between means using Morris and DeShon’s (2002) equation 8.

therefore independently analyzed the data of only those participants who ascribed the exact same level of physical attributes to both the original and the duplicate (~ 30% of the sample). As this is—despite the obvious reduction of statistical power—the most conservative way to analyze the present data, any deviation in ascriptions of retained mental properties could be attributed to an intuitive mind-body dualism.

In line with the results presented above, differences in the ascription of mental properties between original and duplicate ( $M = 1.15$ ,  $SD = 1.78$ ) were significantly greater than the (per definition) non-existent differences in the ascription of physical properties;  $t(28) = 3.47$ ,  $p = .002$ ,  $d = 0.65$ . Similarly, the hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental) interaction remained significant,  $F(1, 28) = 12.01$ ,  $p = .002$ ;  $\eta_p^2 = .30$ .<sup>4</sup>, see Figure 2. This demonstrates that participants' intuitive mind-body dualism cannot solely be attributed to differences in ascriptions of retained physical properties to the duplicate, but rather to a true belief in the independent nature of mental phenomena and physical matter.<sup>5</sup>

However, a second explanation for the attenuated ascription of physical properties to the duplicate could be that participants perceived the items we intended to be entirely physical in nature to be (partly) attributable to mental states. For example, although we found the 12 items we designed to load on two factors corresponding to our mental/physical distinction, some participants may have assumed that a limp can be partly explained by psychological

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<sup>4</sup> The same results can be observed when only taking those participants into the analysis that ascribe *maximum* retention values (i.e., a mean of 7) to physical properties of original and duplicate,  $F(1, 24) = 11.43$ ,  $p = .003$ ;  $\eta_p^2 = .33$  (~24% of participants).

<sup>5</sup> For all of our studies we added additional analyses to the Supplementary Materials, showing that the attenuated ascription of physical properties to the duplicates does not fully explain the attenuated ascription of mental states to the duplicates. Specifically, statistically controlling for differences in ascriptions of physical attributes to original and duplicate does not affect the diverging ascriptions of mental states or effects of our primings on this divergence.

factors, or that a flu is somehow less physical than a scar. Therefore, the observed decrease in ascriptions of physical properties to the duplicate may in fact have been caused by the same processes responsible for the attenuation of ascribed mental properties, without necessarily indicating a disbelief in the accuracy of the duplication device.

{FIGURE 2}

In sum, the present results show that adults seem to intuitively dissociate minds from bodies in a duplication thought experiment. The following two studies were designed to both confirm these results and rule out potential confounds of this measure.

### **Study 1b**

Study 1a revealed that people seem to perceive mental states of a hamster to be partly independent of its physical body. However, giving both hamsters proper names (for identification purposes) may have artificially highlighted the notion that both have a unique identity, commonly understood as having distinct mental states (cf., Gelman & Taylor, 1984; Gutheil et al., 2008). Thus, finding differences in ascriptions of retained mental attributes may have been a function of this potential confound. In fact, Hood and colleagues (2012) found that mind-body dualism in children was indeed more pronounced when the duplicated beings were given proper names. To test whether the same is true for adults, and to rule out that the observed effect is entirely driven by this detail, we decided to replicate Study 1a with a paradigm that does not involve proper names. For this study, we expected the same pattern of results as for Study 1a, with potentially slightly reduced mind-body dualism.

### **Method**

**Participants and design.** Fifty-eight MTurk workers (26 females;  $M_{\text{Age}} = 34.6$ ,  $SD = 12.65$ ) participated in exchange for monetary compensation. All participants worked on a no-name variation of the previously introduced thought experiment.

**Materials and procedure.** To rule out that referring to two differently-named individuals artificially increased the perception of differences in retained mental states, we slightly modified the paradigm from Study 1a. Instead of assigning to the two hamsters the names Jimmy and Bert, they were only referred to as ‘the original hamster’ and ‘the duplicate hamster’. In the list of physical and mental properties that was presented to participants prior to the duplication, the hamster was only referred to as “he” (cf. Table 2). Other than that, the procedure of this study was identical to Study 1a.

## Results and Discussion

No participants were excluded from data analysis.

Consistent with our expectations, the hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental) interaction was significant,  $F(1, 57) = 19.31$ ,  $p < .001$ ;  $\eta_p^2 = .25$

Between original and duplicate, differences in ascription of retained mental properties ( $M = 2.09$ ,  $SD = 1.92$ ) were again greater than were differences in ascription of retained physical properties ( $M = 1.01$ ,  $SD = 1.33$ ),  $t(57) = 4.40$ ,  $p < .001$ ,  $d = 0.60$ .

For the original hamster, there was no difference in ascription of retained physical ( $M = 6.64$ ,  $SD = 0.80$ ) vs. mental properties ( $M = 6.54$ ,  $SD = 0.90$ ),  $t(57) = 1.11$ ,  $p > .27$ . In contrast, participants ascribed to the duplicate hamster a greater retention of physical properties ( $M = 5.63$ ,  $SD = 1.43$ ) than of mental properties ( $M = 4.45$ ,  $SD = 1.78$ ),  $t(57) = 4.80$ ,  $p < .001$ ,  $d = 0.64$  (Figure 3). Replicating Study 1a using a slightly modified paradigm, these results show that the hitherto observed effect cannot solely be attributed to the fact that the two hamsters in Study 1a were given proper names that may have promoted the perception



of mental distinctness. Yet, one could still argue that merely referring to both hamsters as “the original” and “the duplicate” already emphasizes the existence of two distinct individuals. This particular issue can only be ruled out by a paradigm exclusively involving one single individual, such as the one employed in Studies 4a and 4b.

{FIGURE 3}

### **Study 1c**

Although Studies 1a and 1b show that adults seem to reliably dissociate a hamster’s mental from its physical properties, the question remains whether this effect is uniquely tied to animals or whether the same could be expected for people thinking about other human beings. Further, it may be possible that the effects observed thus far could have been caused by some kind of response tendency in participants, who may have felt inclined to answer questions regarding the duplicate hamster differently than questions pertaining to the original. This study was designed to rule out these concerns. First, to show that the observed effect exceeds reasoning about mental states of a hamster, we developed a variation of the thought experiment in which a human being is duplicated instead of a hamster.

Second, to demonstrate that the effect is indeed caused by a decreased attribution of a mind to the duplicate and not by a mere response tendency or any side-effect of item specifics (e.g. a different level of complexity between physical and mental items), we also included a variation of the thought experiment for which we expected participants to indicate no (or only little) dualism, that is, high retention values on both mental and physical items for the original and for the duplicate. More precisely, in this condition a non-living entity (a robot) is duplicated. As a robot is an object that is commonly understood as possessing no brain and hence no mind, we expected to find no indication of mind-body dualism, or—as we have a

natural tendency to anthropomorphize such entities (e.g., Gazzola, Rizzolatti, Wicker, & Keysers, 2007)—to find it significantly reduced.

*Pretest.* We conducted a pretest to determine whether participants in fact ascribe a mind to a robot to a lesser degree than to a human. Eighty MTurk participants ( $M_{\text{Age}} = 20.69$ ,  $SD = 8.38$ ) were presented with the previously outlined 12 statements either describing a robot or a human scientist. They were then asked to indicate on dichotomous scales (*yes* vs. *no*) whether they think the respective entity has a physical body, whether it has a mind, and whether such a human/robot could actually exist. As expected, while participants did not differ in their ascription of a physical body to the scientist (93%) and the robot (85%, Fisher's exact  $p > .30$ ), they ascribed a mind to the robot to a significantly lesser degree (23%) than to the scientist (95%,  $p < .001$ ). Further, participants did not differ in their opinion about whether such a robot (97%) or human (98%) could actually exist ( $p > .99$ ).

## Method

**Participants and design.** One-hundred twenty-two MTurk workers (43 females,  $M_{\text{Age}} = 32.34$ ,  $SD = 10.52$ ) participated in exchange for monetary compensation. All participants were randomly assigned to one of two conditions and worked on a variation of the previously introduced no-names thought experiment task, either involving a human being or a robot as the object of duplication.

**Materials and procedure.** The procedure was for the most part identical to Study 1b. Participants were again presented with twelve properties, this time either describing a human scientist or a robot. To create these variations of the thought experiment paradigm, we modified the twelve properties previously used to describe the lab hamster. In doing so, we tried to come up with properties that match the underlying construct of each original property as closely as possible. For example, while the hamster was trained to find his way through a

complex maze in under 10 seconds, the human scientist was able to solve a Rubik's Cube in under 60 seconds, whereas the robot was programmed to solve a complex math puzzle in under 10 milliseconds (see Table 2).

After being informed about the successful duplication procedure, participants were again asked about the level of retained mental vs. physical attributes of both the original and the duplicate. As before, responses to the six mental and physical attributes for both the original and the duplicate were collapsed to form the respective indices. Reliabilities for these indices were again satisfactory<sup>6</sup>.

{TABLE 2}

## Results and Discussion

No participants were excluded from data analysis.

Comparing the results of the human duplication with the robot duplication, a significant three-way interaction, target (human vs. robot)  $\times$  exemplar (original vs. duplicate)  $\times$  dimension (physical vs. mental/computational), emerged,  $F(1, 120) = 6.64, p = .011, \eta_p^2 = .05$ .

*Human.* Consistent with our expectations, participants indicated for the human being the same mind-body dissociation they previously indicated for a duplicated hamster. A 2 $\times$ 2 within-subjects ANOVA revealed the predicted human (original vs. duplicate)  $\times$  dimension (physical vs. mental) interaction;  $F(1, 66) = 14.07, p < .001, \eta_p^2 = .18$ .

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<sup>6</sup> Cronbach's  $\alpha$ s: Human: Original(physical) = .55, Duplicate(physical) = .75, Original(mental) = .50, Duplicate(mental) = .82.

Robot: Original(physical) = .78, Duplicate(physical) = .81, Original(mental) = .85, Duplicate(mental) = .90.

Again, between original and duplicate, differences in ascription of retained mental attributes were greater ( $M = 1.05$ ,  $SD = 1.30$ ) than differences in ascription of retained physical properties ( $M = 0.48$ ,  $SD = 0.92$ ),  $t(66) = 3.75$ ,  $p < .001$ ,  $d = 0.47$ .

Analyzing responses to each individual human, we again found differences in ascribed mental ( $M = 4.92$ ,  $SD = 1.40$ ) versus physical attributes ( $M = 6.26$ ,  $SD = 0.98$ ) for the duplicate,  $t(66) = 7.61$ ,  $p < .001$ ,  $d = 0.95$ . However, unlike in the previous Studies 1a and 1b, we also found significant differences in ascriptions of retained mental ( $M = 5.98$ ,  $SD = 0.62$ ) versus physical attributes ( $M = 6.74$ ,  $SD = 0.54$ ) for the *original*,  $t(66) = 9.63$ ;  $p < .001$ ,  $d = 1.19$ . That is, participants indicated that the duplication procedure somehow altered the mental states of the original scientist. Although it is not entirely clear why this pattern emerges, it is conceivable that participants perceived the human being to be more aware of the duplication procedure, its purpose, and its implications. These are all factors that may have affected the human emotionally and cognitively, and may as a result have altered his mental states. Still, as reported above, differences were significantly greater for the duplicate, again revealing an intuitive belief in mind-body dualism in participants.

*Robot.* For the robot, we expected participants to indicate no (or a decreased level of) mind-body dualism. Therefore, we took care not to describe the robot in an anthropomorphized manner, in order to not foster the ascription of a mind, which would in theory produce the same pattern of results that we found for the hamster or the human (cf. Table 2).

In line with our reasoning, no significant robot  $\times$  dimension interaction emerged,  $F(1, 54) = 0.01$ ,  $p = .946$ . More precisely, differences between ascribed computational and physical properties were not significantly different between original ( $M = 0.38$ ,  $SD = 0.84$ ) and duplicate robot ( $M = 0.39$ ,  $SD = 0.96$ ),  $t(54) = 0.07$ ,  $p > .9$ . Further, there was no difference between ascriptions of retained computational ( $M = 6.33$ ,  $SD = 1.08$ ) versus

physical attributes ( $M = 6.31$ ,  $SD = 1.00$ ) for the original robot,  $t(54) = 0.23$ ,  $p > .8$ , and likewise no difference between ascriptions of retained computational ( $M = 5.94$ ,  $SD = 1.38$ ) versus physical attributes ( $M = 5.93$ ,  $SD = 1.31$ ) for the duplicate robot,  $t(54) = 0.07$ ,  $p > .9$ .

Exceeding our original hypothesis, we found an intuitive mind-body dissociation only for participants who were asked to reason about another human being, that is, a being that is considered to have a mind, as opposed to a “mindless” robot. While participants assumed that mental states of a human partially vanish during a physical duplication procedure, the same is not true for a robot who possesses similar characteristics, indicating that it is indeed something unique to the perception of minds that drives the effect observed (Figure 4).

{FIGURE 4}

Further, results of this study indicate that the previously reported findings cannot solely be attributed to a response tendency (as participants did not show this tendency for the robot duplication), the fact that the experiments involved an animal rather than a human, to a perceived inaccuracy of the duplication device, or to other attributes specific to the previously used items assessing mental and physical properties.

However, in the subsequent studies, we reverted to using the original hamster paradigm from Study 1a. The reasons for this decision are that—as the present study shows—the hamster paradigm more clearly captures the proposed mind-body dualism in participants, as they seem to perceive the original human’s mental states to be more affected by the duplication procedure than the hamster’s. Second, when presenting participants with a scenario involving the duplication of a human being, religious considerations (e.g., about immortal souls) may undesirably affect their responses.

## Study 2

As research in developmental psychology shows, we all seem to be „natural-born dualists“ (Bloom, 2004). Yet, many children learn rather early in their lives that the brain is factually responsible for any sort of mental phenomena humans and animals may experience (Johnson, 1990). That is, they acquire scientific knowledge about the origins of mental life. However, despite this acquired knowledge, the results of the present studies indicate that even adults tend to intuitively dissociate mental processes from physical matter. Thus, it is possible that the intuitive mind-body dualism that children seem to endorse is still present in adults, who may correct for this intuition by relying on acquired scientific knowledge that opposes dualistic concepts. One can further assume, that this correction process must require the use of cognitive resources to override the default tendency to dissociate minds from bodies. Interfering with this correction process should thus increase responses in line with a belief in mind-body dualism. Therefore, the subsequent study was designed to test the hypothesis that taxing people’s cognitive resources via a cognitive load manipulation will interfere with the aforementioned correction process, resulting in responses indicating more pronounced dualistic beliefs (see Gilbert, 2002).

## **Method**

**Participants and design.** Seventy-three US-American MTurk workers (30 females,  $M_{\text{Age}} = 31.27$ ,  $SD = 9.59$ ) participated in exchange for monetary compensation. Participants were either assigned to a low cognitive load or a high cognitive load condition.

**Materials and procedure.** At the beginning of the experiment, participants were instructed to remember a 7-character code sequence. In the low cognitive load condition, participants were asked to remember a simple string (“1234567”), whereas participants in the high cognitive load condition were asked to remember a complicated string (“n63#m1Q”) (cf., Conway & Gawronski, 2013; DeShon, Brown, & Greenis, 1996). Subsequently, all participants worked on the thought experiment task from Study 1a. Finally, participants were

asked to recall the code sequence they memorized and to indicate on a scale ranging from 1 (*not at all*) to 7 (*very much*) how difficult they found memorizing it.

## Results and Discussion

No participants were excluded from data analysis.

*Manipulation check.* As expected, participants in the high load condition ( $M = 3.92$ ,  $SD = 2.16$ ) found it more difficult to remember the code sequence than did participants in the low cognitive load condition ( $M = 1.35$ ,  $SD = 0.91$ ),  $t(28.53) = 5.69$ ,  $p < .001$ ,  $d = 2.13$ .

*Main analysis.* Consistent with our hypothesis, results of a  $2 \times 2 \times 2$  mixed ANOVA revealed the predicted hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental)  $\times$  cognitive load (low vs. high) interaction,  $F(1, 71) = 5.44$ ,  $p = .023$ ,  $\eta_p^2 = .07$ . Specifically, over both load conditions, we replicated the basic effect from Study 1a,  $F(1, 72) = 50.34$ ,  $p < .001$ ,  $\eta_p^2 = .41$ . Importantly, however, differences in the ascription of retained mental vs. physical properties for the *duplicate* hamster were greater in the high load condition ( $M = 1.77$ ,  $SD = 1.81$ ) than in the low load condition ( $M = 0.90$ ,  $SD = 1.51$ ),  $t(41.74) = 2.05$ ,  $p = .047$ ,  $d = 0.63$ , indicating increased intuitive mind-body dualism in the high load condition. For the *original* hamster, differences in the ascription of retained mental vs. physical properties did not differ between load conditions ( $p > .9$ ) (Figure 5).

{FIGURE 5}

Replicating the main result of the previous studies, participants again showed a clear dissociation of minds and bodies, represented by their diverging ascriptions of retained physical and mental properties to a duplicated hamster. Critically, for participants under

cognitive load a stronger dissociation emerged, suggesting that taxing people's cognitive resources prevents them from correcting their default dualistic beliefs.

### Study 3a

Having shown that taxing people's cognitive resources seems to attenuate their tendency to correct their intuitive dualistic beliefs, another set of studies was designed to test whether this increase in mind-body dualism can in fact be attributed to an increased reliance on intuition rather than to any other effect unique to cognitive load manipulations. As we assume that adults are intuitive mind-body dualists, activating a mindset that promotes intuitive (vs. analytical) thinking should increase dualistic beliefs.

#### Method

**Participants and design.** Sixty-two German university students (40 females,  $M_{\text{Age}} = 25.84$ ,  $SD = 2.96$ ) were recruited via a University mailing-list and participated in exchange for a chance to win one of three 20€ gift certificates. Participants were either assigned to an analytical or an intuitive thinking style priming condition.

**Materials and procedure.** Participants worked on a procedural priming task intended to activate a mindset characterized by an analytical vs. intuitive thinking style. Instructions stated: "Please write a paragraph (approximately 8-10 sentences) describing a time your intuition/first instinct [vs. "carefully reasoning through a situation"] led you in the right direction and resulted in a good outcome." (Shenhav, Rand, & Greene, 2012). Subsequently, participants worked on the thought experiment task from Study 1a.

#### Results and Discussion

Six participants did not work on the priming task and were thus excluded from analyses. Consistent with our prediction, results of a  $2 \times 2 \times 2$  mixed ANOVA revealed the predicted hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental)  $\times$  thinking style



(analytical vs. intuitive) interaction,  $F(1, 54) = 7.94, p = .007, \eta_p^2 = .13$ . Again, we replicated the basic effect from Study 1a over both priming conditions,  $F(1, 55) = 83.40, p < .001, \eta_p^2 = .60$ . Replicating and conceptually extending Study 2, differences in the ascription of retained mental vs. physical properties for the *duplicate* hamster were greater when participants were primed with an intuitive thinking style ( $M = 3.46, SD = 1.88$ ) than when they were primed with an analytical thinking style ( $M = 1.99, SD = 1.99$ ),  $t(54) = 2.81, p = .007, d = 0.77$ , indicating increased intuitive mind-body dualism in the intuitive thinking condition. For the *original* hamster, differences in the ascription of retained mental vs. physical properties did not differ between thinking style conditions ( $p > .6$ ) (Figure 6). Results of this study indicate that the effects reported in Study 2 can indeed be explained by participants relying on analytical thinking in order to partially correct their intuitive belief in mind-body dualism.

{FIGURE 6}

### Study 3b

In this study, we planned on directly replicating Study 3a in a laboratory setting with more participants. We further added two explicit measures of mind-body dualism, one of which was previously used to assess overt dualistic beliefs (Forstmann et al., 2012). As we assume that *explicit* beliefs in dualism are affected by a cognitive correction process that is based on acquired cultural knowledge, we expected to only find a moderate relation between explicit and intuitive measures of dualism. Further, as this knowledge should be readily accessible to participants, we did not expect to find effects of our experimental manipulation on explicit dualistic beliefs.

### Method

**Participants and design.** One-hundred and twenty German university students (63 females,  $M_{Age} = 22.33$ ,  $SD = 2.74$ ) participated in exchange for a chocolate bar. Participants were again assigned to either an analytical or an intuitive thinking style priming condition.

**Materials and procedure.** The procedure was identical to the one employed in Study 3a except that, in addition, participants also answered a set of questions after completing the thought experiment task to assess explicit beliefs in mind-body dualism. First, they responded to a 7-point pictorial measure of mind-body dualism (Forstmann et al., 2012). This item consisted of seven diagrams, each comprised of two circles, vertically centered on a horizontal line. From top to bottom, the circles gradually converged (cf., Schubert & Otten, 2002). The left circle was labeled “body”, the right circle was labeled “mind”. The instructions asked participants to indicate which of the different constellations best represents their idea of how their body relates to their mind. Responses were coded such that high values indicate stronger beliefs in mind-body dualism. This item was followed by a questionnaire comprised of four items assessing agreement with dualistic/physicalistic statements on a scale from 1 (*do not agree*) to 7 (*very much agree*) (e.g., „Minds can exist independently of bodies“). Again, high values indicate stronger beliefs in mind-body dualism.

## Results and Discussion

Similar to Study 3a, 12 participants who did not follow instructions to the priming task were excluded from data analyses. Consistent with our prediction, results of a  $2 \times 2 \times 2$  mixed ANOVA revealed the predicted hamster (original vs. duplicate)  $\times$  dimension (physical vs. mental)  $\times$  thinking style (analytical vs. intuitive) interaction,  $F(1, 106) = 5.55$ ,  $p = .020$ ,  $\eta_p^2 = .05$ . Again, we replicated the basic effect from Study 1a over both priming conditions;  $F(1, 107) = 256.54$ ,  $p < .001$ ,  $\eta_p^2 = .71$ . As in Study 3a, differences in the ascription of retained mental vs. physical properties for the *duplicate* hamster were greater when participants were primed with an intuitive thinking style ( $M = 3.39$ ,  $SD = 1.90$ ) than when they were primed

with an analytical thinking style ( $M = 2.50$ ,  $SD = 2.15$ ),  $t(106) = 2.29$ ,  $p = .024$ ,  $d = 0.44$ , indicating increased mind-body dualism in the intuitive thinking style condition. For the *original* hamster, differences in the ascription of retained mental vs. physical properties did not differ between thinking style conditions ( $p > .7$ ) (Figure 7).

*Explicit measures.* In order to compare the results of the thought experiment task with the subsequent measures, we calculated an overall “intuitive dualism” score. First, differences in the ascription of retained mental vs. physical properties were calculated for both the original and the duplicate hamster. The discrepancy between these difference scores can be understood as representing the strength of a participant’s intuitive belief in mind-body dualism.

This intuitive dualism score was found to be marginally correlated with the pictorial measure of explicit mind-body dualism,  $r(108) = .17$ ,  $p = .073$  and significantly correlated with the four-item scale assessing dualistic beliefs,  $r(108) = .22$ ,  $p = .017$ . However, reliability of the four-item scale was only modest ( $\alpha = .43$ ).

A  $2 \times 2$  mixed ANOVA revealed a significant thinking style (intuitive vs. analytical)  $\times$  dualism type (intuitive vs. explicit[pictorial]) interaction;  $F(1, 106) = 5.74$ ;  $p = .018$ ,  $\eta_p^2 = .05^7$ . Specifically, while the thinking style manipulation affected participants intuitive dualistic beliefs as reported above, explicit dualistic beliefs in the intuitive thinking condition ( $M = 3.09$ ,  $SD = 1.04$ ) did not differ from those reported in the analytical thinking condition ( $M = 3.16$ ,  $SD = 3.12$ ),  $t(106) = 0.32$ ,  $p = .748$ . Thus, in line with the proposition that our thought experiment paradigm assesses intuitive dualistic beliefs, a priming procedure promoting intuitive thinking only affected responses on this particular measure, while not

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<sup>7</sup> Including mean responses to the 4-item dualism scale in the ANOVA instead of the pictorial item revealed a marginally significant priming (intuitive vs. analytical)  $\times$  dualism type (intuitive vs. explicit[scale]) interaction  $F(1, 106) = 2.90$ ;  $p = .092$ ,  $\eta_p^2 = .03$ .

affecting responses on previously used explicit measures of dualism. Further, as theorized, intuitive and explicit measures of mind-body dualism were found to only be moderately correlated. However, given the low reliability of the explicit dualism scale, more research is needed to understand the exact relationship between both constructs.

{FIGURE 7}

### Study 4a

So far, we established a reliable measure of intuitive mind body dualism in adults, showing that people indeed perceive mental and physical properties of a being to be partially independent. Yet, the question remains which processes underlie the observed effect. Specifically, which aspects of the thought experiment may trigger the intuitive separation of mind and body? Therefore, the last set of studies was designed to investigate whether the intuitive mind-body dualism most people seem to share can at least partially be explained by essentialistic reasoning about the nature of the mind.

In order to be able to answer this question, we first developed and validated a single-individual variation of our thought experiment, a task more closely resembling Parfit's (1985) original "teleportation" paradigm. Parfit posed the question, whether a human being that was scanned, destroyed, and artificially recreated from new atoms at a different location could still be considered the same person.

### Method

**Participants and design.** Eighty MTurk workers (34 females,  $M_{Age} = 34.23$ ,  $SD = 10.95$ ) participated in exchange for monetary compensation. All participants worked on a single-individual variation of the previously introduced thought experiment assessing intuitive mind-body dualism.

**Materials and procedure.** In this study, we modified the existing paradigm to only involve one single individual. Specifically, participants were told that Jimmy, the original hamster, was scanned and duplicated, a procedure during which his original body was destroyed. Therefore, the subsequent questions addressing retained physical and mental properties only pertained to that one, “teleported”, hamster. Responses regarding physical properties ( $\alpha = .82$ ) and mental properties ( $\alpha = .96$ ) were each combined to build individual indices representing the perceived retention of the respective dimension. Again, if people do separate minds from bodies and perceive the mind to be an essence not defined by physical properties, they should ascribe to the teleported hamster more retained physical than mental properties.

### Results and Discussion

No participants were excluded from data analysis.

Consistent with our hypothesis that people would dissociate minds and bodies even in the absence of a second being, a paired-sample *t*-test revealed that participants ascribed to the teleported hamster a greater degree of retained physical ( $M = 6.14$ ,  $SD = 1.05$ ) than mental properties ( $M = 5.17$ ,  $SD = 1.86$ ),  $t(79) = 5.23$ ,  $p < .001$ ,  $d = 0.64$ <sup>8</sup>.

Thus, adopting a teleportation paradigm involving only one individual, participants again revealed a dissociation of physical and mental properties: Retained mental properties were ascribed to a teleported hamster to a lesser degree than were physical properties. Additionally, this variation of the thought experiment helps to rule out concerns regarding the presence of two individuals in the duplication paradigm that may have artificially increased mind-body dualism, helps to further rule out issues with potential response tendencies in the

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<sup>8</sup> In this study, 20 participants (~25% of the sample) ascribed maximum retention values (i.e., a mean of 7) to both mental and physical properties of the teleported hamster, revealing a response pattern in line with the notion of physicalism.

duplication paradigm (see Study 1c), and allows to further explore the role of essentialistic thinking in intuitive mind-body dualism in the following study.

### **Study 4b**

This final study was designed to find out more about the processes underlying the effects observed thus far. In order to do so, this study utilizes a variation of the thought experiment from Study 4a to test the proposition that people are “essentialistic dualists”. Specifically, we reasoned that people may perceive the mind to be an essence that is inherent in each physical part that makes up a living being (see Newman & Keil, 2008). If that was the case, replacing the physical parts that make up a being with new parts—as in the hitherto described thought experiments—may strip the being of this essence (and hence its mind), a notion comparable to the ancient Greek allegory of the “Ship of Theseus” (Clough, 2001). This classic thought experiment raises the question that if one was to consecutively substitute every individual part that makes up a ship, does the ship remain the same ship, or does it become a different ship altogether? In the case of atoms and molecules—the basis of the present thought experiment—this question becomes even more striking, as there is technically no way to distinguish one atom from another. They are factually identical.

If people believe the mind to be an immaterial property that constitutes the core essence of an individual and that is attached to its physical matter, the dissociation of mental and physical properties should be greatly reduced if a “teleported” being is merely disintegrated and reassembled, that is, if it is comprised of the very same atoms as it was before that were only transported to a different location (cf., Blok, Newman, & Rips, 2005; Rhemtulla & Hall, 2009). That way, any immeasurable quality (i.e., the mind) that is inherent to the original’s physical parts should survive the teleportation procedure.

### **Method**

**Participants and design.** One-hundred and fifty MTurk workers (66 females,  $M_{\text{Age}} = 37.25$ ,  $SD = 21.31$ ) participated in exchange for monetary compensation. Participants were either assigned to a “recreation” or a “reassembly” variation of the hamster teleportation paradigm from Study 4a.

**Materials and procedure.** To test the idea that essentialistic reasoning about the nature of the mind can explain the effects reported thus far, we first created a variation of the thought experiment introduced in Study 4a, in which the teleportation device is described in a slightly different manner. After they were told that a computer scans the entire object that is to be teleported, participants in the “recreation” condition read that “[the] information is then used to recreate the scanned object in a second chamber [...] from basic chemical elements, molecule for molecule, while the original object is being destroyed.”

Conversely, participants in the “reassembly” condition read that “[the] object is then disintegrated. That is, all molecules of the object are separated from each other and transported through a pipe to a second chamber. The stored information is then used to reassemble the object (B) from its original molecules [...]”. Further the graphical depiction of the apparatus was changed to match the description above (see Supplementary Materials).

Subsequently, participants in both conditions were introduced to the lab hamster, read the 12 facts describing his physical and mental properties, and answered questions regarding their perceived retention of these properties after the teleportation.

## Results and Discussion

No participants were excluded from data analysis.

Consistent with our hypothesis, a  $2 \times 2$  mixed ANOVA revealed the predicted mode of teleportation (recreation vs. reassembly)  $\times$  dimension (physical vs. mental) interaction,  $F(1, 148) = 4.62$ ,  $p = .033$ ,  $\eta_p^2 = .03$ . More precisely, there was a greater difference in the ascription of retained physical vs. mental properties in the condition in which the hamster was

recreated from new molecules than in the condition in which the original molecules were reassembled.

As in Study 4a, when the hamster was created from entirely new molecules, participants ascribed to him a greater retention of physical properties ( $M = 6.15$ ,  $SD = 1.26$ ) than of mental properties ( $M = 5.30$ ,  $SD = 1.70$ ),  $t(82) = 4.79$ ,  $p < .001$ ,  $d = 0.54$ .

Notably though, although the differences between ascriptions of mental and physical properties is greatly reduced in the reassembly condition, it remains statistically significant. Even in this condition, participants ascribe to the teleported hamster a greater retention of physical ( $M = 6.47$ ,  $SD = 0.82$ ) than of mental properties ( $M = 6.10$ ,  $SD = 1.27$ ),  $t(66) = 3.18$ ,  $p = .002$ ,  $d = 0.44$  (see Figure 8), showing that even in this procedure some of the mental essence that is part of the original is lost in the teleportation procedure.

Unexpectedly, we also found a marginally significant difference between the ascription of retained physical attributes to the recreated ( $M = 6.15$ ,  $SD = 1.26$ ) as compared to the reassembled hamster ( $M = 6.47$ ,  $SD = 0.82$ ),  $t(142.07) = 1.91$ ,  $p = .058$ ,  $d = 0.32$ . This may be explainable by participants perceiving the reassembly device to be somehow more accurate in creating a perfect copy than the recreation device. After all, in the recreation device, the parts that made up the original were “destroyed”. This higher accuracy—one could argue—may in turn be responsible for the heightened levels of ascribed mental properties to the reassembled hamster. Therefore, similar to Study 1a, we decided to independently analyze the data of only those participants who—regardless of experimental condition—ascribed the maximum level of retained physical attributes to the respective hamster (~51% of the sample). In line with our reasoning, ascription of retained mental properties remained greater for participants in the reassembly condition ( $M = 6.87$ ,  $SD = 0.28$ ) than in the recreation condition ( $M = 6.10$ ,  $SD = 1.55$ ),  $t(40.68) = 3.05$ ,  $p = .004$ ,  $d = 0.96$ .



{FIGURE 8}

In sum, the present study provides initial process evidence for the intuitive mind-body dualism people seem to entertain. In line with a framework of psychological essentialism, the data suggests that people do indeed perceive mental states to be a non-physical quality that is tightly linked to physical matter, even on a molecular level. While any kind of molecule seems to be sufficient to recreate the physical body of a being, it is only “original” molecules that carry a great portion of that being’s mental properties.

Reassembling the original molecules of the hamster, however, does not fully eliminate intuitive mind-body dualism in participants. Although it is greatly reduced, they still ascribe to the reassembled individual a lesser retention of mental states as compared to the original. One possible explanation could be that people perceive the mind to not just be an essence that is attached to physical property that can be disassembled and reassembled at will. If the mind is considered an emergent property of a certain combination of physical matter, temporarily dissolving the mind may be perceived as irrevocably altering it to some extent. This can be related to the proposition that self-continuity in space and time is a fundamental component of personal identity (e.g., Sani, 2008; Dunkel, 2005), which—in our case—is clearly interrupted by the teleportation procedure.

### **General Discussion**

Using a variety of novel thought-experiment tasks, eight studies converge in demonstrating that adults are intuitive mind-body dualists. Over all studies, participants ascribed to a mechanically duplicated/teleported living being a greater retention of physical than of mental properties. This difference was only found for duplicated beings that were

considered to actually have a mind, and was unrelated to whether the respective being was given a proper name. It was further shown that this intuitive dissociation of minds and bodies may be considered a default: Taxing participants' cognitive resources or priming them with an intuitive (versus analytical) thinking style both increased dualistic beliefs. Lastly, a final set of studies demonstrated that the perceived dissociation of minds and bodies can be partially explained by essentialistic reasoning about the nature of the mind. When the living being was reassembled from its original molecules rather than recreated from (factually indistinguishable) new molecules, mind-body dualism was significantly reduced.

Yet, a lot is still to be learned about the precise manifestation and boundary conditions of the naïve dualism that we find in our studies. From the current set of data, one can assume that participants intuitively endorse a certain degree of Cartesian substance dualism. That is, mental phenomena are considered to be (to some extent) independent from physical matter. If participants were to entertain a classic property dualism—the view that minds are a fully emergent property of, yet not reducible to, neurological activity—they would not show the decreased ascription of mental states to the duplicate being that we find in Studies 1 to 3.

However, our results are also not fully in line with a classic Cartesian substance dualism account, as mental properties are not treated as *fully* independent from physical properties. As our last study shows, people perceive the “mental substance” to be tightly linked to its physical counterpart. In fact, more in line with theories of psychological essentialism, people seem to perceive the mind to be partly inherent in the physical matter that makes up an entity, even on a molecular level. Thus, one could say that people are apparently “essentialistic dualists”. Still, the question whether this particular mental essence is perceived to be uniformly distributed throughout the entity, as has been suggested by some researchers (Newman & Keil, 2008), or whether it is still being primarily located in the head or brain

(Starmans & Bloom, 2012), remains open. Future research may shed some light on this issue, for example, by looking at how variations in malfunctions of duplication procedures or intentional removal of different physical properties affects attributions of specific mental properties.

One noteworthy characteristic of the current thought experiment paradigm, however, is the strictly physical nature of the duplication/teleportation procedure that is conducted. Although this is apparently the most appropriate operationalization for the research questions at hand (i.e., whether participants ascribe to a physical duplicate a lesser retention of mental properties), the question remains whether other effects could be expected from a non-mechanical duplication procedure. If, for example, participants were told a story about a witch that—purely by willpower—magically duplicated or teleported a hamster, differences in ascriptions of retained mental vs. physical attributes could be greatly reduced or even found to be inverted.

Another noteworthy observation is the correlation between intuitive and explicit beliefs in mind-body dualism that we assessed and reported in Study 3b. Although both concepts seem to be related, they do not correlate strongly. A possible explanation could be that either of the measures is not precise enough to capture the underlying construct properly. However, an intriguing alternative explanation could be that explicit and intuitive mind-body dualism are indeed partially independent constructs. In theory, intuitive beliefs could be the result of our phenomenological experience that—either state- or trait-wise—affects our gut feeling about scenarios such as the one presented in our studies. On the one hand, the feeling of occupying our bodies (Bloom, 2004), having a private mental life (Anthony, 2007), experiencing dreams, or engaging in mind-wandering (e.g., Mason et al., 2007), may all contribute to intuitive dualistic beliefs. On the other hand, the experience of our minds being effected by physiological factors such as pain, hunger, or psychoactive substances may foster

intuitive physicalistic beliefs. The same is conceivable for explicit beliefs. While some people may have had a more pronounced exposure to scientific knowledge regarding the physical origins of mental life, for example via education, others' explicit beliefs may have been profoundly shaped by religious or philosophical teachings that emphasize the existence of an immaterial mental substance such as a soul or a spirit. If that was a case, it is possible to think of both intuitive dualists who explicitly endorse physicalistic beliefs and vice versa.

Both the German as well as the US-American culture, that is, the cultures the present research was focused on, are at their core grounded on monotheistic Abrahamic religions, which proclaim both the existence of a supernatural being and the existence of an immaterial soul that survives the death of the physical body. On the other hand, these two societies can also be characterized by a strong prevalence of scientific rationale, which in combination may explain the variance in explicit beliefs in mind-body dualism earlier research reports (Proctor, 2008; Hook & Farah, 2013; Forstmann et al, 2012). People with different cultural or religious backgrounds—for example from societies in Asia or Africa—may very well differ in their explicit endorsement of dualistic or physicalistic statements (cf. Chudek et al., 2013). However, despite these cultural differences, our shared cognitive foundations should lead to a culturally ubiquitous presence of intuitive dualistic beliefs.

As argued, finding this intuitive belief in mind-body dualism may help better understand important real-world phenomena such as the culturally ubiquitous emergence of religious and superstitious beliefs (Bering, 2006). Most religions involve some form of afterlife belief, which requires to accept the notion that some aspect of a person survives after his or her physical body ceases to exist, which is only possible when entertaining the idea that minds and bodies are somehow distinct. Further, as dualistic beliefs can be considered a logical requirement for ascribing minds to non-human entities, intuitive dualism may partially explain beliefs in supernatural agents, which have been found to be intimately linked to mind-

perception and anthropomorphism (Gervais, 2013). However, this ability to ascribe minds to non-living entities may also have potentially negative side effects. If, for a dualists, perceiving minds is a process that is independent from perceiving physical bodies, they may similarly be more inclined to *not* perceive minds in people, that is, they may mentally strip others of their minds. Denying other people a mind—and thus a uniquely human attribute—is a key element in out-group derogation and dehumanization (Haslam, 2006).

To conclude, in order to fully understand human cognition and behavior, it's crucial to understand how people themselves explain the world—that is, how they believe social and non-social entities to operate. As these beliefs are fundamental to our understanding of the world, finding out more about their nature and their underlying processes on multiple levels of analysis is key for understanding why humans think and act the way they do in nearly every aspect of their lives.

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