Supplementary Materials for Online Publication

# The Cartesian Folk Theater:

# People conceptualize consciousness as a spatio-temporally localized process in the human brain.

**Additional theoretical background: Lay beliefs about the mind (and its relation to the body)**

Past studies found that lay people have theories about the nature of the mind, especially with regard to how it relates to the human body. It has been argued that people are naturally inclined to view immaterial minds and material bodies as distinct entities, a notion referred to as mind-body dualism (Burgmer & Forstmann, 2018; Forstmann & Burgmer, 2015, 2017; Forstmann, Burgmer, & Mussweiler, 2012; Bloom, 2004; Bering, 2006). This inclination becomes evident, for example, in our tendency to anthropomorphize non-human entities, that is, to ascribe human-like mental states to living or non-living things that do not possess human brains (e.g., Epley, Waytz, & Cacioppo, 2007)—a phenomenon omnipresent throughout human history, from animist belief systems in early human societies (Bird-David, 1999) to folklore, fairy tales, and contemporary TV ads. Likewise, belief in disembodied spirits, demonic possession, or an afterlife rely on the notion that mental states are not entirely reducible to configurations of physical matter but can exist on their own (Boyer, 2001; Bering, 2006; Uhlmann et al., 2008).

Providing initial evidence for the hypothesized ubiquity of dualist beliefs, developmental research found the inclination to dissociate minds from bodies to be present from early childhood on. In a study by Hood, Gjersoe, and Bloom (2012), for example, 5-6-year-old children believed that an ostensibly duplicated hamster would retain the original's physical properties, but *not* retain the original's previously-acquired mental states. Conversely, another study found that children ascribed to a fictional dead mouse—residing in the afterlife—the continuing capacity to have certain mental states (such as affective or cognitive states), but less so the capacity to have (psycho-) biological states (such as pain or hunger) (Bering & Bjorklund, 2004). In both cases, children intuitively considered mental states to not fully rely on the presence of a physical body.

Presumably, this common-sense dualism is a by-product of certain fundamental cognitive processes that humans are equipped with to navigate their social world. Specifically, it was theorized that humans possess a "hyperactive agency detection device"—a strong drive to seek out agents in their environment (Barrett & Johnson, 2003). To understand an agent's behavior and to predict its future behavior—an evolutionary highly adaptive ability—it is not sufficient to merely analyze the agent's overt actions. Rather, it is essential to make inferences about underlying mental states: motives, intentions, desires, all of which provide information that may be useful in future interactions with the agent. This mentalizing ability or "theory of mind", our ability to acknowledge mental states of others, requires us to differentiate between observable bodies and principally unobservable mental states. It was argued that this construal of the world, differentiating between agents and non-agents, forms the basis of dualist beliefs (Bloom, 2004). At the same time, people perceive their *own* mental life (specifically, their own conscious experience) as private and exclusively accessible to themselves, potentially further strengthening their dualist intuitions (Burgmer, Forstmann, & Todd, 2019; Forstmann & Burgmer, 2017).

It is thus not surprising that adults show a similar response pattern as do children in studies probing their intuitive belief in dualism (Forstmann & Burgmer, 2015), and that some form of *explicit* belief in mind-body dualism can be encountered in virtually every culture in human history (e.g., Chudek, McNamara, Birch, Bloom, & Heinrich, 2018; Cohen, 2007; Roazzi, Nyhof, & Johnson, 2013; Slingerland & Chudek, 2011, but see also Astuti & Harris, 2008). It was thus argued that thinking in dualist terms can be considered a cognitive default that most humans share (Bloom, 2004; Forstmann & Burgmer, 2015), and which stands at odds with acquired explicit knowledge about the biological foundation of mental life.

How these metaphysical lay beliefs may affect people's belief in a Cartesian Theater will be discussed in the respective methods section below.

## Pilot Study

Before running Study 1 (see main document), we ran a highly similar pilot study, the design and results of which we describe below.

### Method

**Participants and design.** A total of 451 participants were recruited via the online crowd-sourcing platform Amazon Mechanical Turk (MTurk) and participated in exchange for modest monetary compensation. Of those participants, 53 were excluded for admitting having answered randomly or in a purposefully wrong manner, or because they indicated that they completed the survey on a mobile. This left a final sample of 398 participants (216 female, 180 male, 2 other/none; $M_{\text{Age}} = 36.37$, $SD = 11.91$). As in Study 1, all participants worked on a computer-administered drawing task, asking them to locate brain areas responsible for motor control (control item) and consciousness (critical item).

**Materials and procedure.** Upon consent, participants were first asked to indicate the type of device they used to complete the survey. They were then introduced to the drawing task and worked on the tutorial described in Study 1.

*Main drawing task (control).* On the screen following the tutorial, participants were introduced to the first drawing task, intended to assess the control dimension. Participants were told: "*Below you see a picture of the human brain. Please imagine that this was a picture of your* *brain. For this first task, please use your brush to colorize the area(s) of your brain which you think are responsible for controlling your body movement. Please do not look up the answer on the internet, as we are interested in people's intuitions. You can paint as much or as little as you deem necessary*."

As in Study 1, we had participants imagine it was *their* brain that was displayed on the canvas in order to circumvent issues related to the epistemological "problem of other minds", pertaining to the lack of definite knowledge about other people's conscious experience, that might lead to biased responses on the critical item.

*Main drawing task (critical).* All participants then proceeded to the critical drawing task, assessing our main dependent variable—lay beliefs about the location of consciousness. In this pilot study, participants were asked to "*use [their] brush to colorize the area(s) of [their] brain where [they] think [their] consciousness is located.*".

*Beliefs about mind-body relations.* Following the drawing tasks, participants worked on an unrelated study on people's lay beliefs about artificial intelligence that was appended due to budget constraints. This study included a questionnaire assessing people's lay beliefs about mind-body relations (Forstmann & Burgmer, 2018; Hook & Farah, 2013), which produces two scores representing distinct lay beliefs: belief in reductive physicalism and in substance dualism, respectively. Reductive physicalism refers to a philosophical position that conceptualizes the mind as something than can be entirely reduced to physical states. It is assessed through agreement with six statements, including "*The mind and the brain are the same thing*" and "*The mind is fundamentally physical",* on 7-point Likert-type scales ranging from 1 (*not at all*) to 7 (*very much*). Belief in substance dualism, on the other hand, is a belief that posits that the mind (or the soul) is something that is fundamentally non-physical and that exists outside and independent of the physical realm. This belief is assessed through agreement with six statements, including "*The mind is a nonmaterial substance that interacts with the brain to determine behavior*" and "*Some nonmaterial part of me (my mind, soul, or spirit) determines my behavior*". As discussed above, it is reasonable to assume that these beliefs are related to how people conceptualize the role of the brain in consciousness, and that they may thus affect where people locate it in the brain. Specifically, it is reasonable to assume that people who hold dualistic beliefs would consider the brain to be less involved in conscious experience. We therefore exploratorily analyzed the relation between these two lay beliefs and people's location of consciousness. Based on Descartes' view that the soul is connected to the human body at a specific location in the brain, we reasoned that a belief in substance dualism would correspond to a more spatially "confined" conception of consciousness. Consistently, lay people who view consciousness as independent from the brain should be less inclined to localize the former in the latter, resulting in higher confinement scores.

At the end of the two surveys, participants were asked to provide demographic information (age, sex, gender, nationality, location, native language, level of education, and political orientation), and to indicate on a single binary item whether they responded to one or multiple items in a random or purposefully wrong manner.

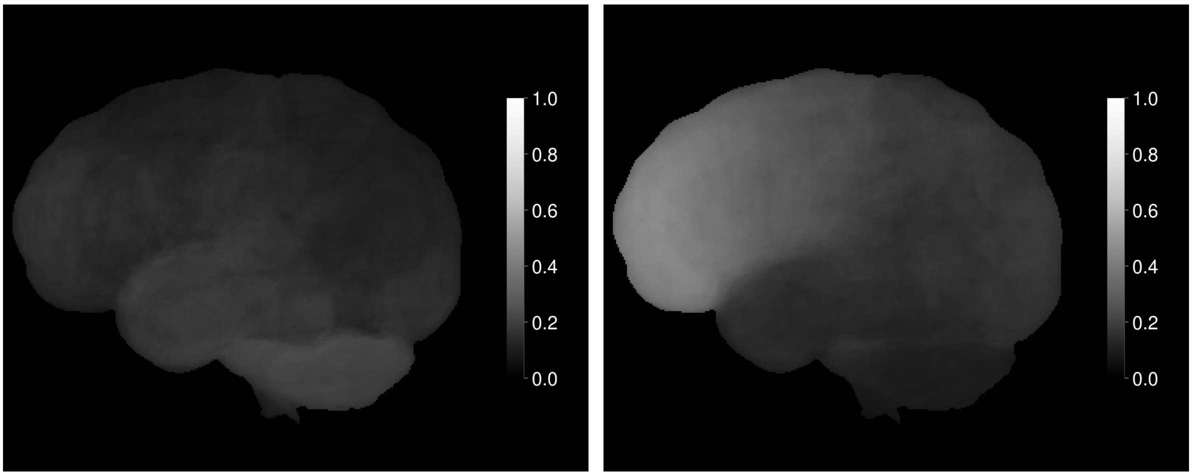
**Results**

Data was prepared as described in Study 1.

**Activation.** We found that, on average, participants colorized 21.6 % of the pixels inside the brain ($M$ = 10,123.49, $SD$ = 10,649.28) when asked to locate consciousness, a number significantly smaller than half of all available pixels, $t(397) = -24.95$, $p$ < 001, 95% CI = [9,074.06, 11,172.926], $d = -1.25$.

The same was true for the control item, that is, the area of the brain responsible for motor control. On average, participants colorized 14.1% of all pixels to locate this faculty (*M* = 6,620.72, *SD* = 7,367.16), which is again less than a half of the available pixels $t(397) = -45.56$, $p < .001$, 95% CI = [5,894.73, 7,346.72], $d = -2.28$. This also shows that people colorized more pixels when locating consciousness than when locating areas responsible for motor functions, $t(397) = 5.98$, $p < .001$, 95% $CI_{\Delta}$ = [2,351.00, 4,654.53], $d_z = 0.30$.

**Location.** Visualizing participants' mean drawings revealed results similar to those reported in Study 1 of the main manuscript (Figure SOM1). Once more, participants located consciousness in the frontal part of the brain, whereas they located motor control further in the back.



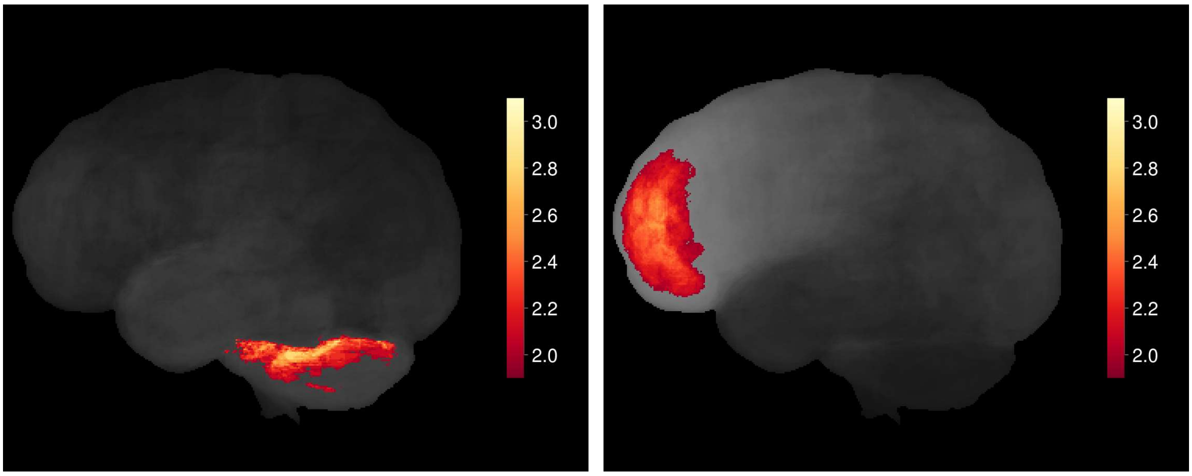



*Figure SOM1*. Average drawings created by participants in the control (left) and consciousness trials (right) in the pilot study. Brightness of each pixel indicates the frequency with which it was colorized by participants (in percentages). Highlighted pixels (bottom row) are pixels colorized significantly more often by participants than others (alpha = .05), with values representing *z*-scores.

Further, to compare participants' responses to the critical task and the control task, we created a difference matrix, representing relatively more frequent colorization of a pixel in one as compared to the other condition (Figure SOM2). For each pixel, we analyzed whether it was colorized significantly more frequently in one condition compared to the other using Fisher's exact test (as chi$^2$ approximations for some of the less frequently colorized pixels may be inaccurate).

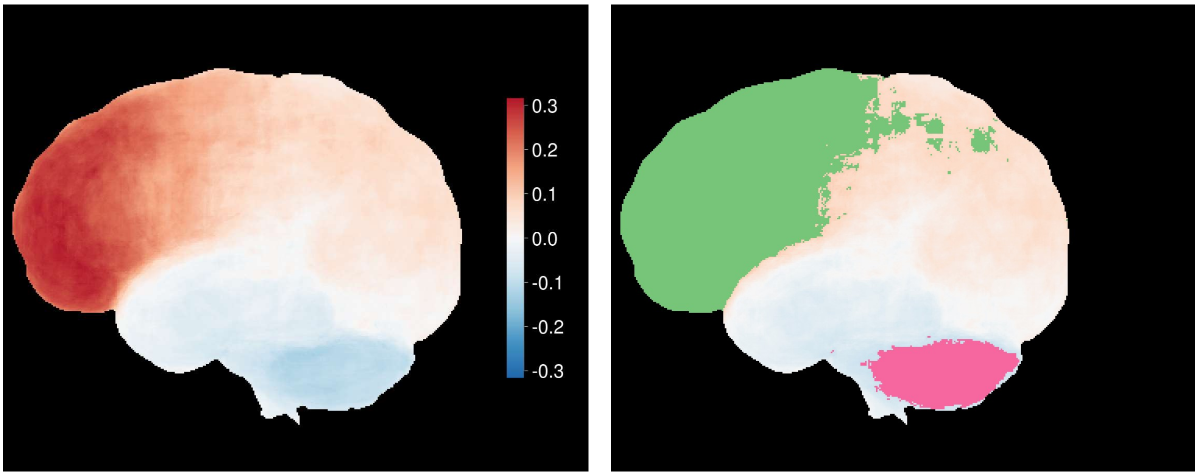



*Figure SOM2.* Differences between control and critical trials in the pilot study. Red colors indicate a greater relative colorization of a pixel in the critical trial, whereas blue indicates more frequent colorization in the control trial (left). Highlighted pixels indicate pixels that were significantly more frequently colorized in the critical trial (green) or in the control trial (pink), as determined by Fisher's exact test (right).

**Spatial orientation**. We found that on average participants located consciousness more frontal ($M$ = -0.14, $SD$ = 0.47) than motor control ($M$ = 0.03, $SD$ = 0.43, $t(392)$ = -4.58, $p$ < .001, 95% $CI_{\Delta}$ = [-0.24, -0.10], $d_z$ = -0.23. As can be assumed from looking at Figure SOM2, they also located motor control further down ($M$ = 0.05, $SD$ = 0.42) than consciousness ($M$ = -0.11, $SD$ = 0.31), $t(392)$ = 5.76, $p$ < .001, 95% $CI_{\Delta}$ = [-0.21, -0.10], $d_z$ = 0.29. Interestingly, the left-right orientation ($r(391)$ = -.34, $p$ < .001, 95% $CI_r$ = [-0.43, -0.25]), but not the up-down orientation ($r(391)$ = -.07, $p$ = .172, 95% $CI_r$ = [-0.17, 0.03]), of the two drawings was negatively correlated: regardless of where on the X-axis of the brain participants located consciousness, they tended to locate motor control at a different location, suggesting that they indeed have distinct views about the location of mental faculties in the brain.

To further quantify participants' localizations of the two faculties, it is possible to test their orientation vectors against 0, that is, against a non-preference for left/right (or up/down) location. Results of these analyses reveal that participants indeed have tendency to locate consciousness in the front, $t(395) = -5.80$, $p < .001$, 95% CI = [-0.18; -0.09], $d = -0.29$, and up, $t(395) = -7.01$, $p < .001$, 95% CI = [-0.14; -0.08], $d = -0.35$, while they tend to locate motor control further down from the center, $t(392) = 2.17$, $p = .030$, 95% CI = [0.004; 0.09], $d = 0.11$, without significant deviations from the center on the horizontal dimension, $t(392) = 1.48$, $p = .140$, 95% CI = [-0.01; 0.07], $d = 0.07$.

**Dispersion**. For consciousness, 95.5% ($n = 378$) of participants colorized only a single cluster of pixels, while only 4.5% ($n = 18$) colorized more than one cluster, a distribution significantly different from chance, binominal test: $p < .001$, 95% $CI_{prob}$ = [0.93, 0.97]. Likewise, we found that the majority of participants colorized a single cluster of pixels for motor control (93.4%, $n = 366$) as opposed to multiple clusters (6.6%, $n = 26$, binominal test: $p < .001$, 95% $CI_{prob}$ = [0.90, 0.96]). These two proportions were not significantly different from one another, $\chi^2(1) = 1.26$, $p = .262$.

**Beliefs about mind-body relations.** Following the established procedure (Forstmann & Burgmer, 2018), we computed two mean scores representing participants' belief in reductive physicalism ($M = 4.62$, $SD = 1.47$, Cronbach's $\alpha = .88$) and substance dualism ($M = 4.14$, $SD = 1.74$, $\alpha = .90$). Both subscales were expectedly negatively correlated, $r(396) = -.64$, $p < .001$, 95% $CI_r$ = [-.70, -.58].

First, we set out to explore whether any (or both) of the two beliefs would indeed predict the degree to which participants view consciousness as taking place in a specific confined location in the brain. To that end, we ran a regression analysis predicting centrality of consciousness drawings (i.e., confinement scores). As predictors, we included participants' belief in substance dualism, in reductive physicalism, as well as the confinement scores of their control-task drawings. The latter was included to control for general colorization preferences unrelated to the concept of consciousness.

Results revealed that confinement of control drawings positively predicted confinement of consciousness drawings, $b = 0.37$, $SE = 0.05$, $p < .001$, 95% CI = [0.26, 0.47]. Controlling for this relationship, belief in reductive physicalism did not predict confinement of consciousness drawings, $b = 0.80$, $SE = 1.04$, $p = .443$, 95% CI = [-1.25, 2.85]. In turn, however, confinement was indeed significantly predicted by participants' belief in substance dualism, $b = -2.16$, $SE = 0.88$, $p = .014$, 95% CI = [-3.89, -0.43]. In other words, a greater belief in substance dualism (i.e., a belief in a mind or soul that exists outside of the physical realm) negatively predicted the average distance between two colorized pixels, representing a greater degree of belief in consciousness happening at a single confined area in the brain. As such, while it may not necessarily be the pineal gland, people who believe in a non-physical soul that may survive bodily death are more inclined to also believe that a smaller, more confined area of the brain is involved in consciousness.

To visualize the difference between people who do or do not subscribe to belief in substance dualism, we median-split the sample on this score and created individual outputs for these two groups of participants (Figure SOM3). As can be seen, greater belief in substance dualism corresponds to generally lesser colorization of pixels, while both groups still revealed the basic tendency to locate consciousness in the frontal part of the brain.

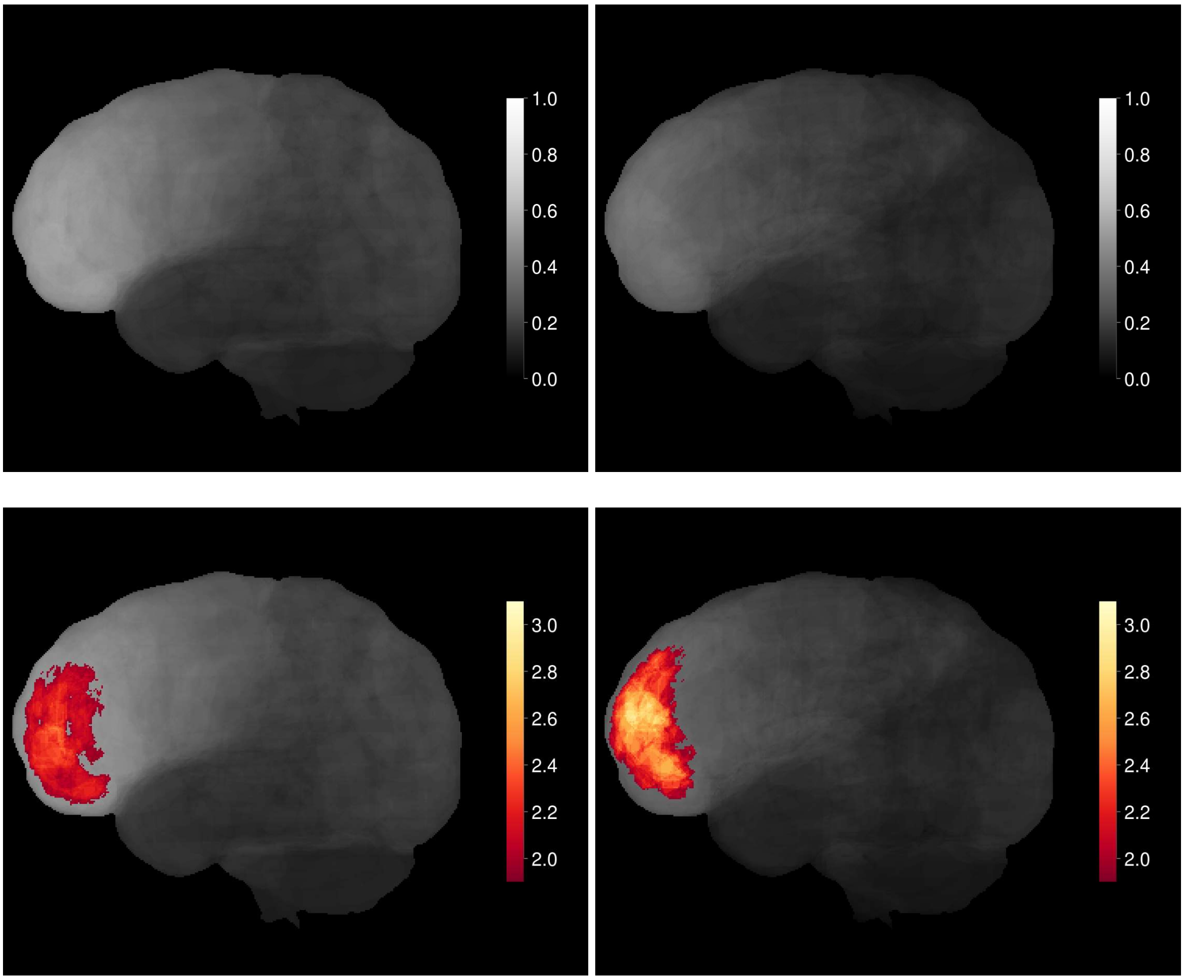



*Figure SOM3*. Brain areas colorized for consciousness by participants low (left) and high (right) in belief in substance dualism.

**Study 1 - Additional results for mind-body dualism**

In the following, we will detail the results for the mind-body relations scale included in Study 1 (see main document). Based on the exploratory results from Study 1, we tested whether lay beliefs about mind-body relations (i.e., substance dualism and reductive physicalism) and free will (i.e., free will and determinism) predict participants views on this question. As in Study 1, we expected that belief in substance dualism would positively predict the degree by which participants locate consciousness in a confined area in the brain, controlling for the related beliefs in reductive physicalism, free will, and determinism. Past research found that both types of metaphysical beliefs are indeed related (Forstmann & Burgmer, 2018; Nadelhoffer et al., 2014), yet we specifically expected substance dualism to emerge as a significant predictor, even when controlling for these related beliefs.

**Methods**

Following the main drawing tasks (see main manuscript), participants completed the first part of the Free Will Inventory (FWI) by Nadelhoffer and colleagues (2014). Specifically, they were asked to indicate for a set of ten statements how much they agreed or disagreed with each of them on a Likert-type scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The FWI has a two-factor structure and allows for the calculation of two mean scores, one representing participants' belief in free will (based on items such as "*How people's lives unfold is completely up to them*"), and one representing their belief in determinism (based on items such as "*Everything that has ever happened had to happen precisely as it did, given what happened before.*").

Subsequently, all participants completed the mind-body relations questionnaire described in the pilot study, assessing their beliefs in substance dualism and reductive physicalism, respectively. We computed mean scores for the four individual subscales of the two questionnaires, representing lay beliefs in free will ($M$ = 5.17, $SD$ = 1.25, $\alpha$ = .89), in determinism ($M$ = 3.15, $SD$ = 1.35, $\alpha$ = .85) in substance dualism ($M$ = 4.42, $SD$ = 1.56, $\alpha$ = .85), and in reductive physicalism ($M$ = 4.55, $SD$ = 1.33, $\alpha$ = .88), respectively.

**Results**

We computed mean scores for the four individual subscales of the two questionnaires (see main manuscript), representing lay beliefs in free will ($M$ = 5.17, $SD$ = 1.25, α = .89), in determinism ($M$ = 3.15, $SD$ = 1.35, α = .85) in substance dualism ($M$ = 4.42, $SD$ = 1.56, α = .85), and in reductive physicalism ($M$ = 4.55, $SD$ = 1.33, α = .88), respectively.

Predicting confinement of consciousness (that is, mean distance between colorized pixels; see Study 1) from the four metaphysical belief subscales, and including confinement of the control drawing as a control variable, revealed a pattern similar to that found in the pilot study: Once again, confinement of the control drawing positively predicted confinement of consciousness in the brain, $b$ = 0.46, $SE$ = 0.05, $p$ < .001, 95% CI = [0.36, 0.57]. More importantly, however, belief in substance dualism again predicted greater confinement of consciousness, $b$ = -2.25, $SE$ = 1.09, $p$ = .041, 95% CI = [-4.40, -0.10]. None of the other subscales significantly predicted confinement (all $p$s > .39).

**Additional results for Study 1b**

**Activation.** In the control condition, participants colorized 32.15% of all available pixels ($M$ = 15,072, $SD$ = 11,785.24), a number significantly smaller than 50% of all pixels, $t(376) = -13.79$, $p < .001$, 95% CI = [13,879.14, 16,266.1], $d = -0.71$. Unlike in Study 1a, participants did not considered a larger part of the brain to contribute to consciousness than to motor control, $t(376) = -1.13$, $p = .261$, 95% $CI_{\Delta}$ = [-1,862.54, 505.55], $d_z = -0.06$.

**Location.** Despite of the counterintuitive eraser paradigm, participants revealed a similar response pattern as in Study 1a (see Figures SOM4 & SOM5.).

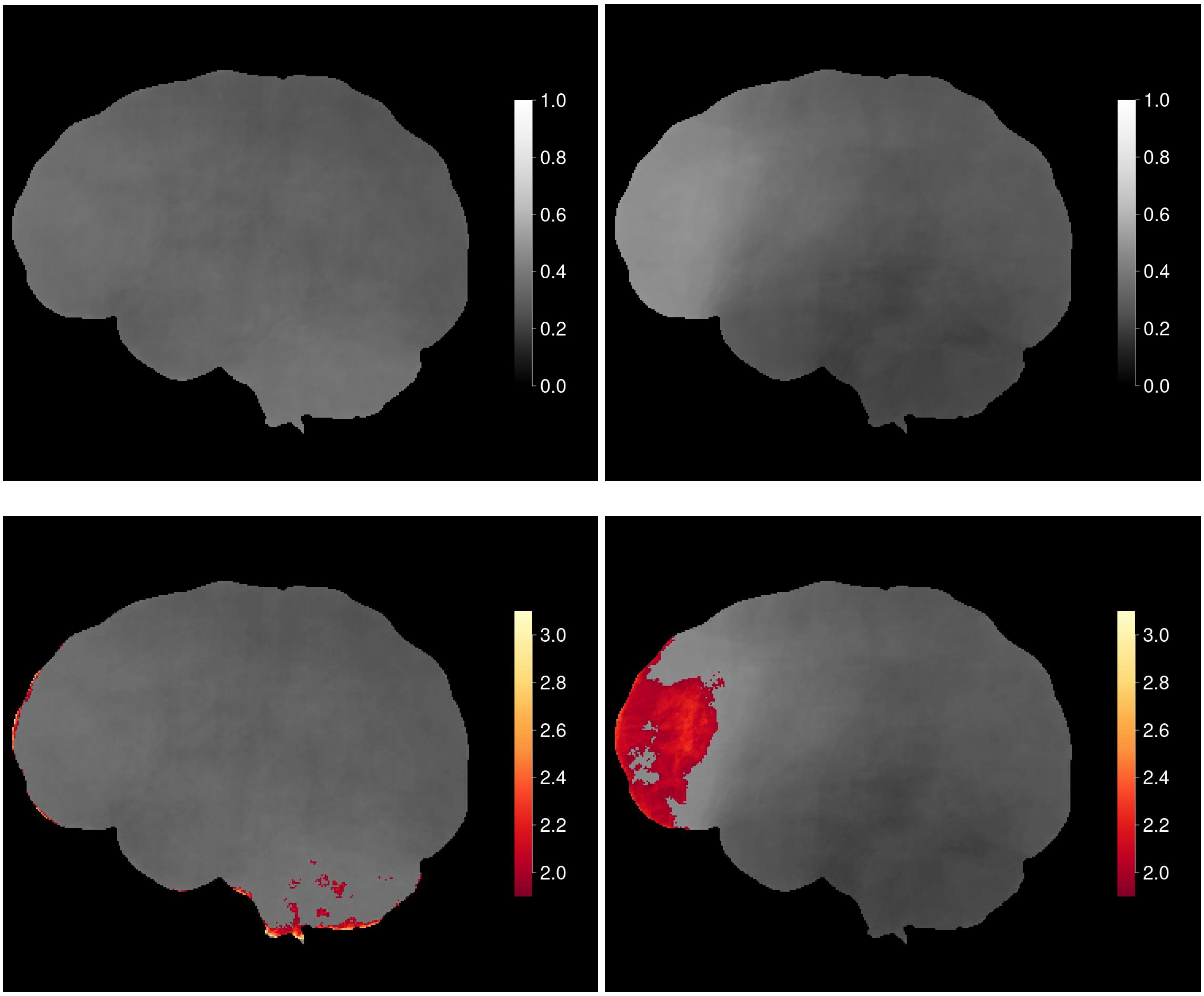


*Figure SOM4*. Average drawings created across all participants in the control (left) and consciousness trials (right) in Study 1b (eraser paradigm). Brightness of each pixel indicates the frequency with which it was colorized by participants (in percentages). Highlighted pixels (bottom row) are pixels colorized significantly more often by participants than others (alpha = .05), with values representing *z*-scores.

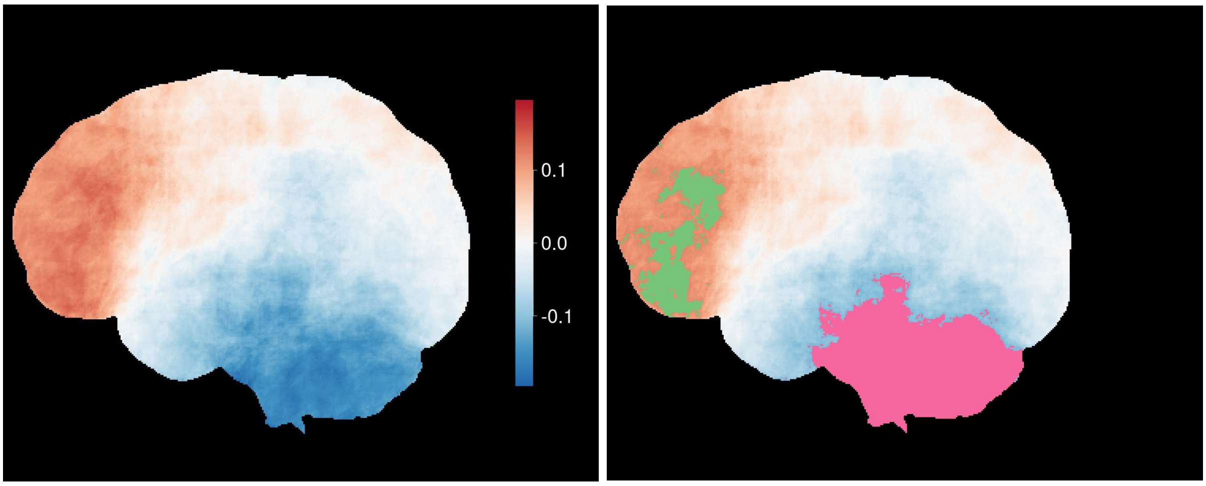



*Figure SOM5.* Differences between control and critical trials in Study 1b. Red colors indicate a greater relative colorization of a pixel in the critical trial, whereas blue indicates more frequent colorization in the control trial (left). Highlighted pixels indicate pixels that were significantly more frequently colorized in the critical trial (green) or in the control trial (pink), as determined by Fisher's exact test (right).

**Spatial orientation.** Analyzing the spatial orientation scores, we found that on average, unlike in Study 1a, participants did not locate consciousness more frontal ($M$ = -0.05, $SD$ = 0.29) than motor control ($M$ = -0.02, $SD$ = 0.24, $t(369)$ = -1.10 , $p$ = .270, 95% $CI_{\Delta}$ = [-0.07, 0.02], $d_z$ = -0.06. They did, however, locate motor control further down ($M$ = -0.01, $SD$ = 0.22) than consciousness ($M$ = -0.06, $SD$ = 0.21), $t(369) = -2.80$, $p = .005$, 95% $CI_{\Delta}$ = [-0.08, -0.01], $d_z$ = 0.15. Similarly matching the results of Study 1a, the left-right orientation ($r(368) = -.21$, $p < .001$, 95% $CI_r$ = [-0.31, -0.12]), but not the up-down orientation ($r(368) = -.08$, $p = .142$, 95% $CI_r$ = [-0.18, 0.03]), of the two drawings was negatively correlated. Regardless of where on the X-axis of the brain participants located consciousness, they tended to locate motor control at a different location, supporting the hypothesis that they indeed have distinct views about the location of these two mental faculties.

To further test whether people locate consciousness in the frontal part of the brain, we once more tested the orientation vectors of the two faculties against 0, that is, against the mid-coronal and mid-axial plane, respectively. As in Study 1a, participants located consciousness in the front $t(374) = -3.01$, $p = .002$, 95% CI = [-0.08, -0.02], $d$ = -0.16, and up, $t(374) = -5.37$, $p < .001$, 95% CI = [-0.08, -0.04], $d$ = -0.28. Motor control, unlike in Study 1a, was neither located significantly in the front/back, $t(370) = -1.60$, $p = .111$, 95% CI = [-0.05, 0.01], $d$ = -0.08, or up/down, $t(370) = -1.06$, $p = .290$, 95% CI = [-0.03, 0.01], $d$ = 0.05.

**Dispersion.** For motor control, 77.5% ($n$ = 292) of participants colorized a single cluster of pixels (vs. 20.4%, $n$ = 77); binominal test: $p < .001$, 95% $CI_{prob}$ = [0.75, 0.83]. These proportions did not significantly differ from the one's reported for the consciousness trial in the main manuscript, $\chi^2(1) = 2.68$, $p = .101$.

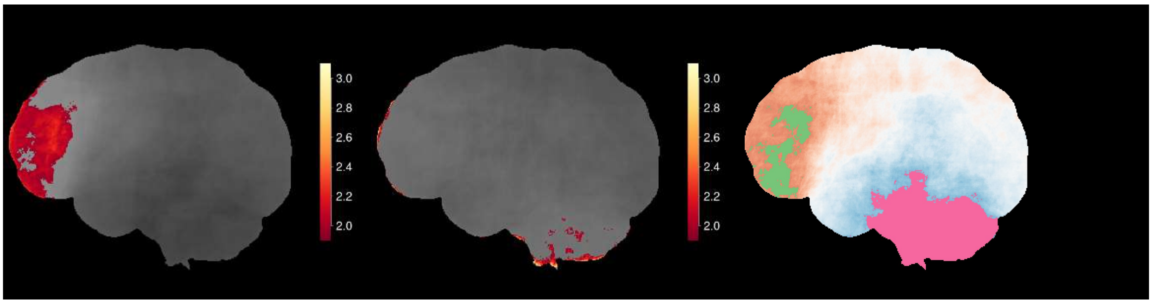
**Rationales for colorization and correlates.**

*Drawings by various subsets of participants.*

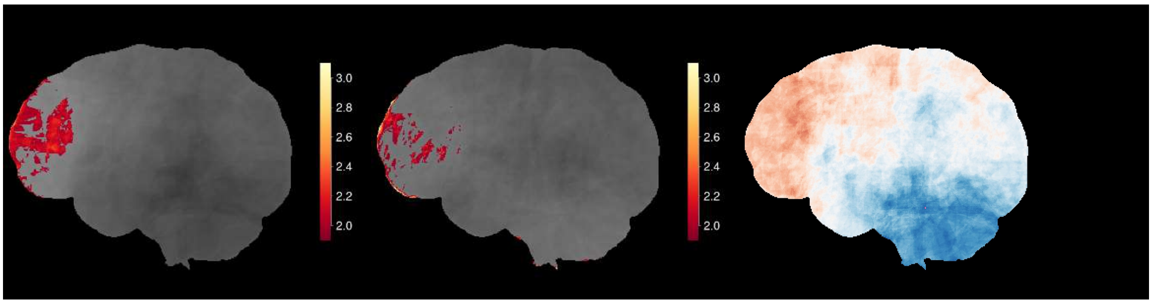
In the following, we detail the average drawings created by various subsets of participants (from left to right: consciousness, motor control, difference; see main manuscript).

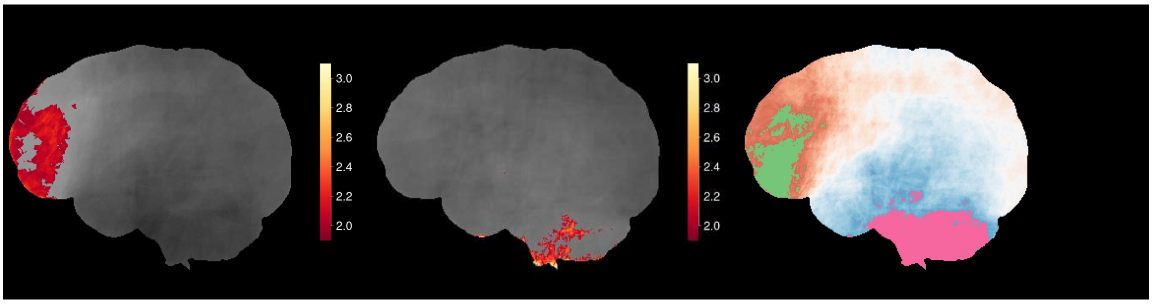
*Figures SOM6.*

Average drawings across all participants in Study 1b:

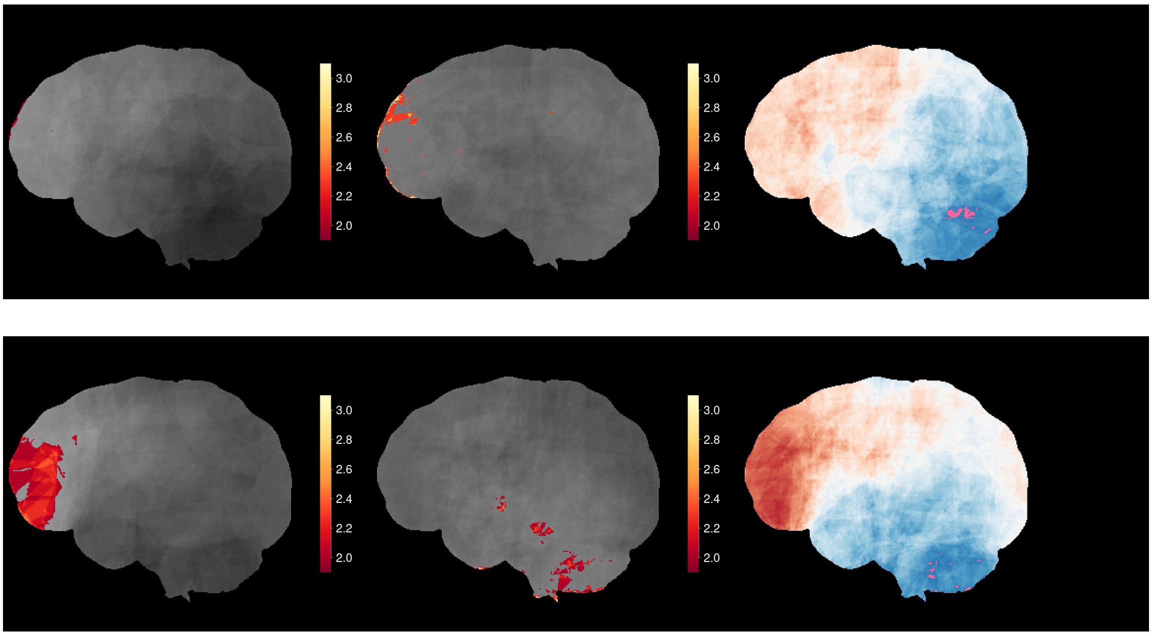



Drawings by participants who scored low (top) versus high (bottom) on the neuro quiz assessing objective knowledge about the brain (median split):

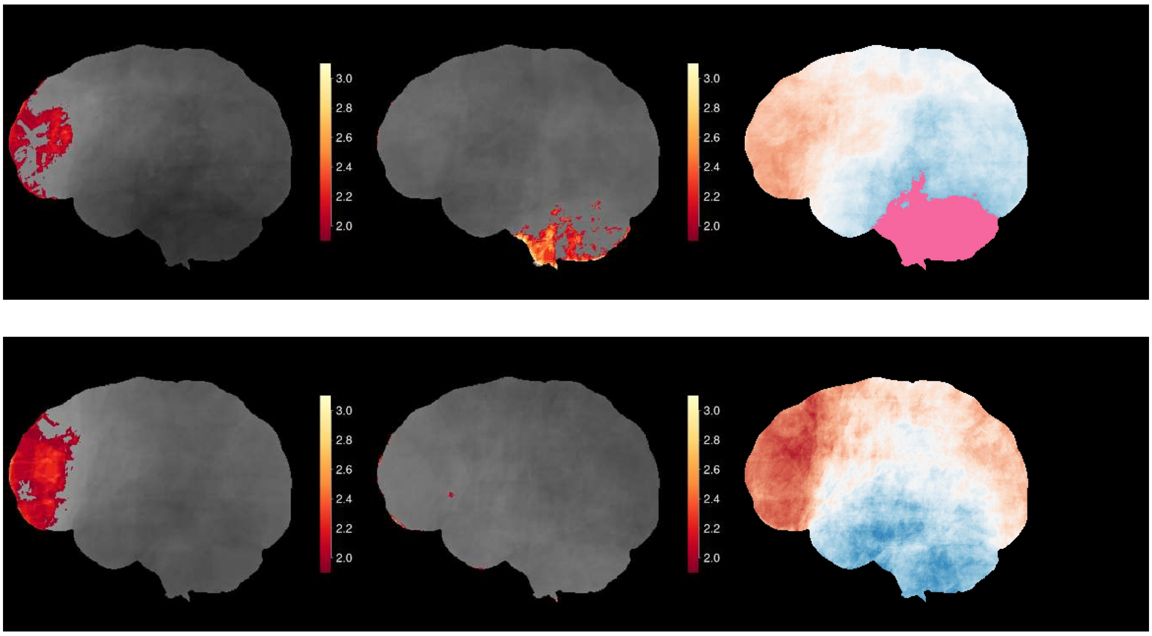


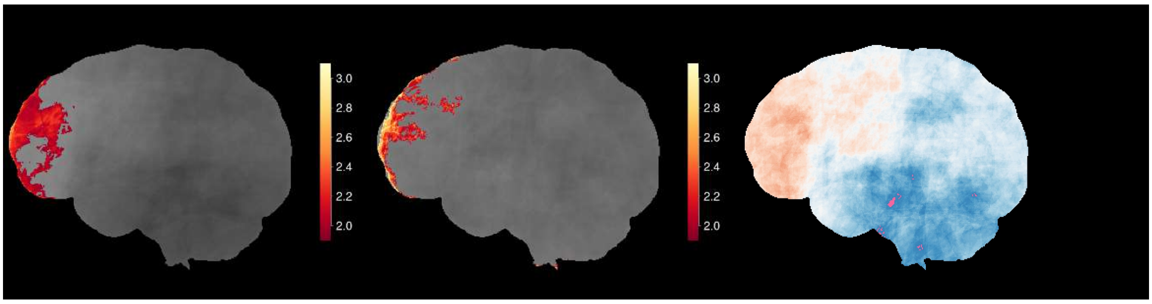

Drawings by participants who scored very low (top) versus very high (bottom) on the neuro quiz assessing objective knowledge about the brain (quartile split):

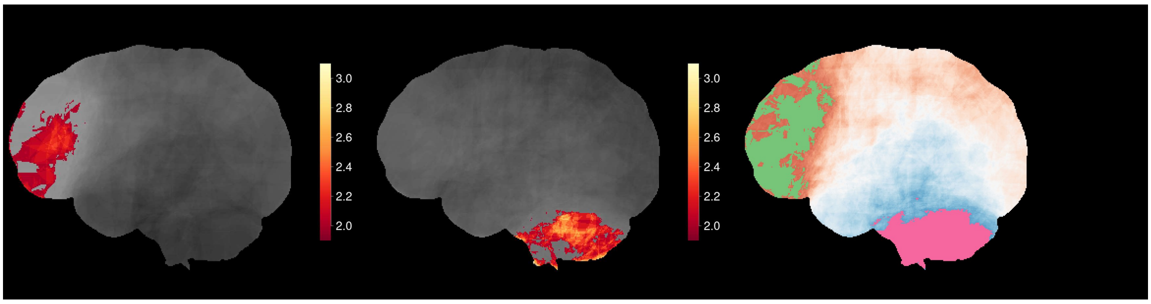



Drawings by participants who scored low (top) versus high (bottom) on the subjective knowledge scale (median split):

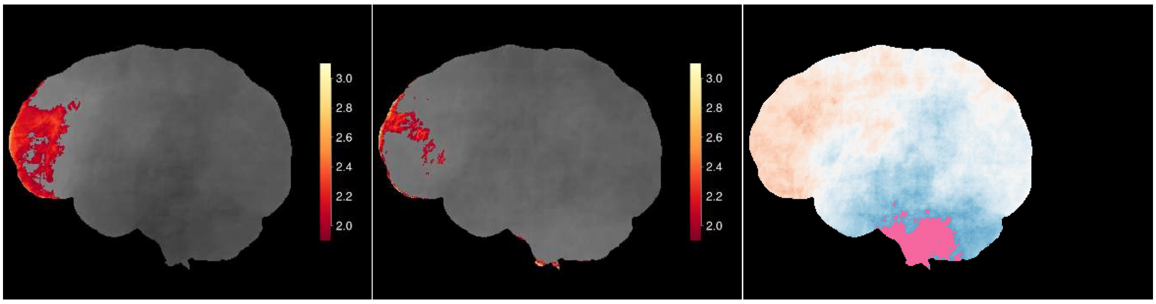


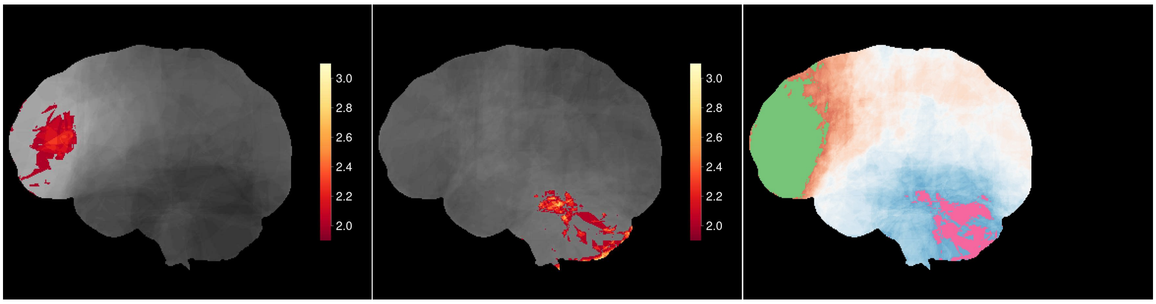
Drawings by participants who have an intuitive (top) or reflective (bottom) information processing style (based on a k-means cluster analysis of the two scores produced by the CRT; see main document for details):



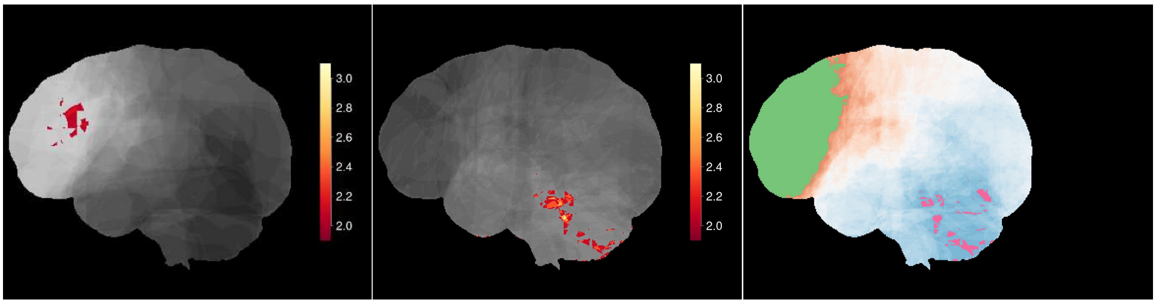




Drawings by participants who rather relied on gut feeling (top) vs. knowledge (bottom) while working on the colorization task (based on a k-means cluster analysis of the two variables; see main document for details):

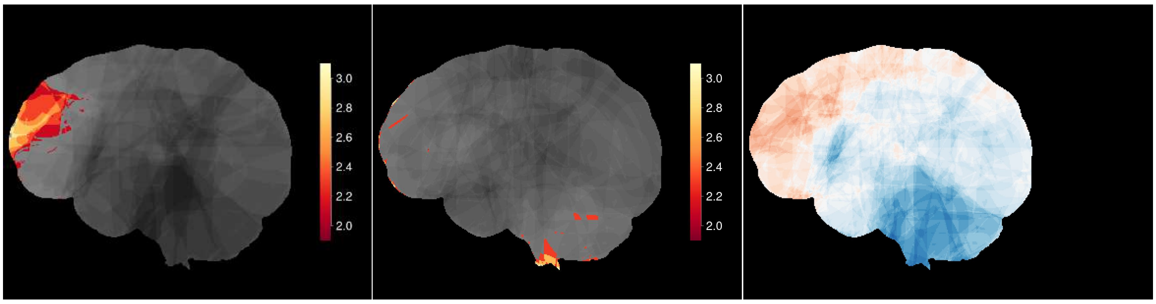




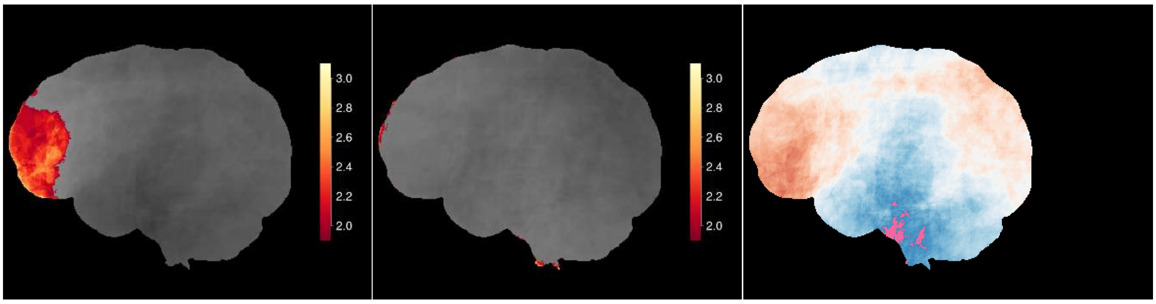

Drawings by participants who chose a scientific rationale as their main rationale for localizing consciousness:




Drawings by participants who chose a naive rationale as their main rationale for localizing consciousness:




Drawings by participants who chose the intuitive rationale as their main rationale for localizing consciousness:




**Correlation table for motor control.**

Table SOM1. *Correlations with confidence intervals between our key variables (1-4) and additional correlates in the control trial (motor control) (Study 1b)*

| | | | Key variables | | | | Correlates | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. Confinement (rev.) | 68.16 | 25.92 | | | | | | | | |
| 2. Orientation (L-R) | 152.98 | 40.75 | -.07 | | | | | | | |
| | | | [-.17, .03] | | | | | | | |
| 3. Orientation (U-D) | 149.95 | 57.20 | **.11*** | **.40**** | | | | | | |
| | | | [.00, .21] | [.31, .48] | | | | | | |
| 4. Dispersion | 1.67 | 2.82 | **.25**** | -.02 | -.01 | | | | | |
| | | | [.15, .34] | [-.12, .08] | [-.11, .09] | | | | | |
| 5. Neuro-quiz score | 6.20 | 1.46 | .03 | .07 | .05 | .04 | | | | |
| | | | [-.07, .13] | [-.03, .17] | [-.06, .15] | [-.06, .14] | | | | |
| 6. Self-reported knowledge | 2.45 | 1.27 | .06 | .02 | -.00 | .10 | **.15**** | | | |
| | | | [-.05, .16] | [-.08, .12] | [-.10, .10] | [-.00, .20] | [.05, .25] | | | |
| 7. CRT (reflection) | 1.80 | 1.46 | -.08 | **.14**** | .05 | .03 | **.15**** | **.14**** | | |
| | | | [-.18, .02] | [.04, .24] | [-.06, .15] | [-.08, .13] | [.05, .25] | [.04, .24] | | |
| 8. CRT (intuition) | 1.69 | 1.31 | **.11*** | **-.16**** | -.04 | .00 | **-.17**** | **-.16**** | **-.88**** | |
| | | | [.01, .21] | [-.26, -.06] | [-.14, .07] | [-.10, .10] | [-.27, -.07] | [-.26, -.06] | [-.90, -.85] | |
| 9. Neuro experience | 1.28 | 0.65 | .05 | .08 | .03 | .04 | **.13*** | **.55**** | .02 | -.02 |
| | | | [-.05, .15] | [-.03, .18] | [-.07, .13] | [-.06, .14] | [.02, .22] | [.47, .61] | [-.08, .12] | [-.13, .08] |

*Note*. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. Confinement is reverse coded, so that high values represent *less* confinement; * $p < .05$; ** $p < .01$.

**Materials used in Study 1b**

***Subjective knowledge about the brain:***

In general, how would you rate your knowledge about the human brain?

[1 = completely disagree; 7 = completely agree]

I would consider my knowledge about the brain to be very good

I know specifics about how our sense organs interact with the brain

I know specific details about how information is processed by the brain

I have a good understanding of how neurons and synapses work

I know more than the average person about which parts of the brain are responsible for what

I feel knowledgeable enough to discuss the human brain with other people

I know which neurotransmitters play a role in the various operations of the brain

***Objective knowledge about the brain (adapted from Herculano-Houzel, 2002):***

Please answer the following 11 true/false questions to the best of your knowledge (again, please do not look up the answers on the internet. Your compensation does not depend on how many of these questions you get right)

[true / false]

An olfactory cell can identify thousands of different odors. (F)

Memory is stored in the brain much like in a computer, that is, each remembrance goes in a tiny piece of the brain. (F)

The brain itself is not sensitive to pain; this is why brain surgery can be performed under local anesthesia (T)

When a brain region is damaged and dies, other parts of the brain can take up its function. (T)

Normal embrionary development of the human brain involves birth but also death of brain cells. (T)

Any brain region can perform any function. (F)

Coma is a deep sleep state. (F)

Motor coordination works independently of the sense of touch. (F)

Mental effort raises oxygen consumption by the brain. (T)

Damaged portions of the human brain regenerate and get well again. (F)

Our brain has maps of the surface of the body and of the visual field. (T)

***Rationale for colorization***

We would now like to know why you chose the brain regions you chose - that is, which thoughts went through your head when you worked on the colorization task.

Note, that there is no correct response and that no response is better than another -- we would just like to get an accurate idea about what went through people's head when they worked on the colorization task.

In the colorization task about consciousness, I chose the brain region(s) that I chose, because...

[1 = completely disagree, 7 = completely agree]

[scientific]

... I learned that these brain regions are associated with higher level thinking.

... I learned that these brain regions are known as a "hub" for consciousness.

... I learned that these brain regions are the evolutionarily newest

[naïve]

... it subjectively feels like this is where "I" am in my head.

... these brain regions are closest to the eyes (the window to the soul).

... it is in line with my spiritual/religious beliefs about where the soul/mind manifests.

[random response]

... I just picked a random spot in the brain.

[intuition]

... I just had a vague feeling that this is where consciousness takes place, but I don't know why.

[no clear rationale]

... I had to colorize something, and this was my first idea.

***Rationale for colorization (single choice)***

If you had to choose, which of these explanations was your single main reason for coloring the area you colorized in the consciousness drawing task.

[same choices as above]

***Cognitive reflection task (CRT; Sirota & Juanchich, 2018)***

Please answer the following four questions.

[Questions and answers presented in random order. Below, the first response represents the correct reflective response, whereas the second response represents the wrong intuitive response]

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

- 5 cents
- 10 cents
- 9 cents
- 1 cent

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

- 5 minutes
- 100 minutes
- 20 minutes
- 500 minutes

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

- 47 days
- 24 days
- 12 days
- 36 days

If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?

o 4 days

o 9 days

o 12 days

o 3 days

**Study 2b, replication of Study 2 using the eraser paradigm from Study 1b**

In addition to Study 1a, we also replicated Study 2 using the eraser paradigm introduced in Study 1b. Due to study length constraints, this study did not include any additional correlates or assessments of participants' rationales, but was rather a direct replication of Study 2 using the new eraser paradigm.

**Method**

**Participants and design.** 291 participants were recruited from a psychology student subject pool in the UK and received course credit for participation. Ninety participants had to be excluded from data analyses (16 for indicating purposefully wrong responding, 13 for admitting to having cheated, and 61 for failing one of two attention check items that were implemented due to concerns about participants' attention). This left us with a final sample of 201 participants (51 female, 147 male, 3 other/none, $M_{\text{Age}} = 19.23$, $SD = 1.50$). All participants worked on a conscious thinking and an unconscious thinking trial (eraser paradigm), presented in random order.

**Materials and procedure.** The design of the study was highly similar to that of Study 2, with a few modifications. Specifically, as in Study 1b, participants were presented with a modified brain outline, including the eyes, as well as labels indicating the front and back of the brain. Likewise, participants completed the version of the colorization task introduced in Study 1b, in which they were asked to use an eraser to remove color from the canvas rather than add to it. After the tutorial for the eraser task (see Study 1b), participants were asked to locate the area(s) of the brain which they thought contribute to *conscious* and *unconscious thinking*, respectively, by using their eraser to remove color from those areas which they thought were not involved in the respective process. Both tasks were presented in random order (see Study 2, main manuscript).

Subsequently, participants were asked to indicate on a binary item, whether they cheated on the task by looking up information on the internet and were asked to complete two attention check items. Specifically, they were asked whether the brain in the image faced to the left or the right, and whether they had to erase color from those areas that they thought did (did not) contribute to (un-)conscious thinking.

Finally, participants provided demographics, and responded to another binary question asking them whether they responded to one or multiple in a purposefully wrong manner.

**Results**

**Activation.** Replicating Study 2, and despite the use of the eraser paradigm, for conscious thinking, participants colorized an area ($M$ = 20,002.34, $SD$ = 12,930.17, number of pixels) smaller than half of all available pixels, $t(200) = -3.77$, $p < 001$, 95% CI = [18,203.93, 21,800.76], $d = -0.27$. Likewise, when locating unconscious thinking, people also colorized less than half of all available pixels ($M$ = 20,237.91, $SD$ = 13,237.27), $t(200) = -3.43$ $p < 001$, 95% CI

= [18,396.78, 22,079.04], $d$ = -0.24, a number that was not significantly different from that for conscious thinking, $t(200) = -0.21$, $p = .834$, 95% $CI_{\Delta}$ = [-2449.32, 1978.19], $d_z = -0.01$.

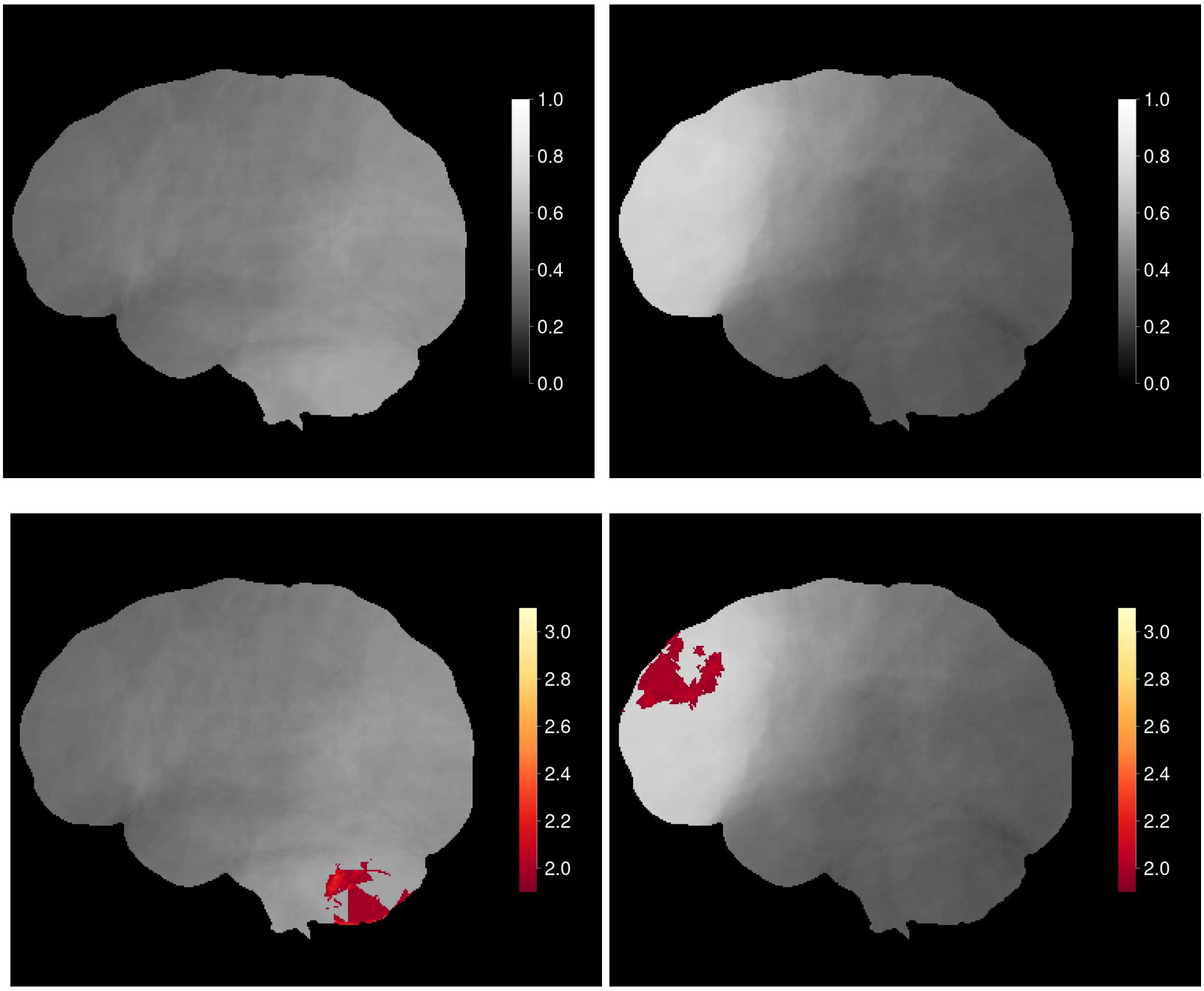



*Figure SOM7.* Average drawings created by participants in the unconscious (left) and conscious (right) thinking trials in Study 2b. Brightness of each pixel indicates the frequency with which it was colorized by participants (in percentages). Highlighted pixels (bottom row) are pixels colorized significantly more often than others (alpha = .05), with values representing $z$-scores.

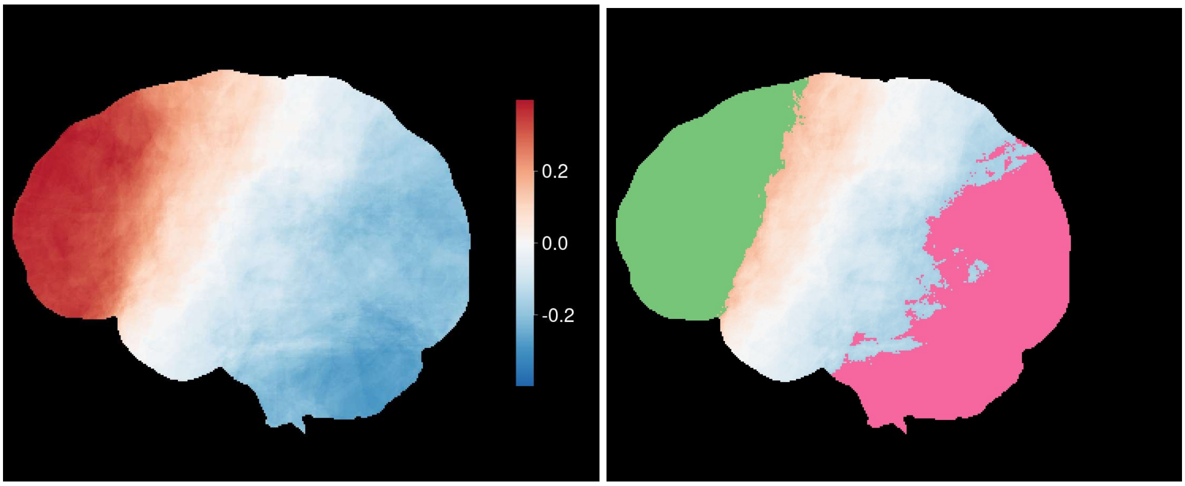



*Figure SOM8.* Differences between location of conscious and unconscious thinking (Study 2b). Red colors indicate a greater relative colorization of a pixel for conscious thinking, whereas blue indicates more frequent colorization for unconscious thinking (left). Highlighted pixels indicate those pixels that were significantly more frequently colorized for conscious (green) or unconscious (pink) thinking, as determined by Fisher's exact test (right).

**Location.** Figure SOM7 displays the location of conscious and unconscious thinking across participants. We once more found that people locate conscious thinking in the frontal part of the human brain. Unconscious thinking, on the other hand, was again located in the occipital part of the brain (cf. Figure SOM8).

**Spatial orientation**. Providing further support for the hypothesis that participants would locate conscious thinking in a different location than unconscious thinking, the left-right orientation vectors (but not the up-down vectors) were negatively correlated, $r(195) = -.14$, $p = .054$, 95% $CI_r = [-.27, .00]$.

Further, similar to Study 2 in the main manuscript, participants located conscious thinking more frontal ($M = -0.08$, $SD = 0.25$) than they did unconscious thinking ($M = 0.06$, $SD$

= 0.22), $t(196) = -5.69$, $p < .001$, 95% $CI_\Delta = [-0.19, -0.09]$, $d_z = -0.41$. Similarly, they located conscious thinking ($M = -0.09$, $SD = 0.2$) further up than unconscious thinking ($M = 0.00$, $SD =$ 0.2), $t(196) = -4.99$, $p < .001$, 95% $CI_\Delta = [-0.13, -0.06]$, $d_z = -0.36$. Individually comparing the orientation vectors against the mid planes (i.e., a non-preference for left/right and up/down orientation), we once more found that conscious thinking was located in the front of the brain, $t(197) = -4.61$, $p < .001$, 95% CI = [-0.12, -0.05], $d = -0.33$, and up, $t(197) = -6.46$, $p < .001$, 95% CI = [-0.12, -0.06], $d = -0.46$, while unconscious thinking was located in the back, $t(197) = 3.54$, $p < .001$, 95% CI = [0.02, 0.09], $d = 0.25$, but did not different from the mid plane on the vertical axis, $t(197) = 0.22$, $p = .830$, 95% CI = [-0.03, 0.03], $d = 0.02$.

**Dispersion**. As in Studies 1a, 1b, and 2 in the main manuscript, most participants colorized a single cluster of pixels when asked to highlight areas responsible for conscious thinking (77.1%, $n = 155$ vs. 20.9%, $n = 42$), a ration significantly different from randomness; binomial test: $p < .001$, 95% $CI_{prob} = [0.71, 0.83]$. Values for unconscious thinking were highly similar (76.1%, $n = 153$ vs. 22.4%, $n = 45$; binomial test: $p < .001$, 95% $CI_{prob} = [0.70, 0.82]$). Both ratios did not significantly differ from one another, $\chi^2(1) = 0.01$, $p = .906$.

**Confinement.** As in Study 2 of the main manuscript, we tested whether confinement differed between the two conditions. Unlike in our main study, participants did not reveal a greater confinement of unconscious ($M = 80.70$, $SD = 27.27$, average pixel distance) than of conscious thinking ($M = 79.65$, $SD = 27.21$), $t(196) = -0.25$, $p < .803$, 95% $CI_\Delta = [-4.84, 3.77]$, $d_z$ = -0.02.

## Additional Results for Study 4

*Different senses.* Participants revealed a highly similar pattern of results, regardless of which sense they were asked to consider. Specifically, a one-way ANOVA revealed that differences between confinement of processing and experience did not significantly differ between senses, $F(1, 403) = 0.82$, $p = .367$. Likewise, there was no main effect of sense on the difference between the absolute number of pixels colorized for experience and processing, $F(1, 406) = 0.16$, $p = .693$. Therefore, while Figure SOM9 show that participants colorized different amounts of pixels depending on which sense they were considering when completing the task (possibly due to the vividness or perceived complexity of the respective sense), the key effect we reported in the main manuscript, namely that participants consider experience to be more confined to a single area in the brain than computation, did not depend on the which sense they considered. As such, although it may have added additional noise to our data, the inclusion of multiple senses in this study proved to be a helpful addition in finding support for the hypothesis of a lay belief in a Cartesian Theater that is related to beliefs about consciousness rather than specific sensory perceptions.

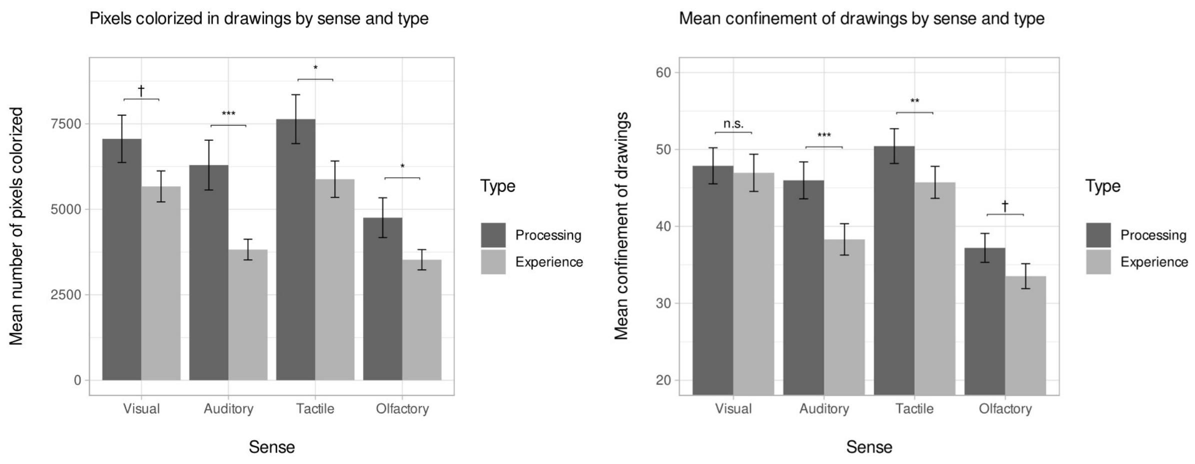



*Figure SOM9.* Comparison of confinement (right) and pixels colorized (left) by sense and type (i.e., aspect of the phenomenon) (Study 4)

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