Strong but wrong: Adult's intuitions of functional and mechanistic knowledge

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Abstract

Function – what a thing is for – and mechanism – how a thing's parts interact to make it work – are considered by cognitive psychologists and philosophers of science to be integrally related despite people's acute sensitivity to their differences. Here, we set out to better characterize lay adults' intuitions about functional and mechanistic knowledge (Study 1). Then, we use learning studies to investigate to what degree these intuitions accurately capture functional and mechanistic cognition (Studies 2, 3). While some intuitions (e.g., that mechanism is more difficult to learn than function) are supported by these learning studies, others (e.g., that function should precede mechanism in explanations) are not. Possible reasons for matches and mismatches are explored.

Keywords: knowledge; function; mechanism; epistemic inferences; learning outcomes

Introduction

In professional motocross, riders have expert-level knowledge of how to engage the functions and features of their dirt bike. At the professional level, mechanics' knowledge of how the dirt bike works is arguably equally important to optimizing performance. In this example, the rider represents functional knowledge – knowledge of what a thing is for, or what its purpose is – while the mechanic represents mechanistic knowledge – knowledge of how a thing's component parts causally interact to make it work. Consider what epistemic intuitions this example brings to mind: Does one of these two experts possess greater knowledge than the other? Is one of these knowledge types more difficult to acquire than the other? Does it seem that one of these knowledge types is typically, or even must be, learned before the other?

If we consider a more mundane example that does not conflate knowledge with performance, such as knowing the function or mechanism of a microwave, these intuitions may become more obvious. We would surely say that someone who understands how a microwave works knows more about microwaves than someone who knows that a microwave heats food. Someone who knows the mechanism of a microwave likely knows its function, but the reverse intuition seems less likely. Here, we seek to characterize adults' intuitions of functional knowledge, mechanistic knowledge, and the relation between them, before then investigating whether these intuitions might reflect the reality of functional and mechanistic cognition.

Philosophers of science have often considered the degree of interrelatedness of function and mechanism in nature (e.g., Craver, 2013). Perhaps most notably, prior work has considered the hierarchal decomposability of nature (Povich & Craver, 2017; Craver, 2015; Simon, 1969). That is, an entity (e.g., a dirt bike) possesses both a function and a mechanism, but so too does each of its component parts (e.g., its engine). The distinction between function and mechanism from a philosophical perspective is in many ways unclear: explaining an entity's mechanism, for example, entails communicating the individual functions of its parts (Bechtel, 2011).

Despite the integral relation between function and mechanism, psychologists have demonstrated that adults and even children easily distinguish between the two information types. While a phenomenon can be appropriately explained by appealing either to its function or its mechanism (Joo et al., 2022; Lombrozo & Wilkenfeld, 2019), adults nevertheless find that mechanism and function bring about unique understandings and have "distinct phenomenology" (Lombrozo & Wilkenfeld, 2019). Even children implicitly acknowledge when it is situationally appropriate the endorse functional explanations (Kelemen, 1999b) or ask functional questions (e.g., when considering whole artifacts; Grief et al., 2006) and when it is not (e.g., when considering whole animals). Adults too implicitly understand when 'why' questions are requesting functional rather than mechanistic information (Joo et al., 2022).

Though extensive consideration has been given to relative preferences and endorsement of functional and mechanistic explanations, much less work has considered relevant epistemic inferences. One study (Chuey et al., 2020) finds that children believe mechanistic knowledge to be more generalizable than fact-based knowledge. One of the few studies to epistemically juxtapose function and mechanism suggests that mechanistic knowledge is considered more valuable than functional knowledge when fixing an object

In L. K. Samuelson, S. L. Frank, M. Toneva, A. Mackey, & E. Hazeltine (Eds.), *Proceedings of the 46th Annual Conference of the Cognitive Science Society.*

(Lockhart et al., 2019, Study 4).

Prior work that does consider epistemic inferences regarding function and mechanism suggests that adults' intuitions may be strong yet inaccurate. For example, adults indicated a lesson about a combustion engine was appropriate for 18-year-olds, yet children as young as 6 years were able to learn not only important labels but also the system's critical causal relations (Chuey et al., 2021). Similarly, adults demonstrate robust beliefs that explanations should provide functional information before mechanistic information (McCarthy & Keil, 2023), yet teaching accordingly confers no benefit to learners (McCarthy et al., 2024). Given a shift toward prioritizing the teaching of scientific mechanisms (NGSS, 2013), it is important to better characterize adults' intuitions of causal knowledge and determine whether these beliefs accurately reflect functional and mechanistic cognition.

Current Studies

The current studies first investigate the nature of adults' intuitions by probing various factors, each directly juxtaposing function and mechanism (Study 1). We predict that adults will find mechanism to be greater in magnitude and difficulty to acquire and that function will be considered as more easily learned first or independently. Based on prior work (McCarthy & Keil, 2023), we expect adults to indicate that function should precede mechanism in a lesson. We also expect participants to indicate that mechanistic knowledge implies understanding of corresponding functions more than function implies mechanism. Next, we consider whether these intuitions reflect learning outcomes by varying the order of functional and mechanistic information in an explanation (Study 2) and by teaching just one information type at a time (Study 3). Each study considers the breadth of potential findings by considering both artifacts (e.g., laser welder) and biological parts (e.g., fish's swim bladder), though we do not expect to find domain differences.

Study 1

Functional and mechanistic information have often been juxtaposed, especially in the context of explaining biological and artificial phenomena (Kelemen 1999a, Kelemen 1999c, Lombrozo & Gwynne, 2014). Prior work has found mechanistic knowledge to be more valuable (Lockhart et al., 2019) given specific goals, but no work has yet extensively investigated adults' intuitions without specific goals in mind. Here, we directly contrast function with mechanism to better characterize adults' intuitions of how these two knowledge types interact and how they are acquired. Studies were pre-registered with AsPredicted.org and pre-registrations, data, and supplemental materials are available on OSF (DOI 10.17605/OSF.IO/V32X6).

Methods

Sixty adult participants completed studies online at Prolific.com. All studies were pre-registered via AsPredicted.org. All power analyses were conducted using pwr package version 1.3-0 (based on Cohen, 1988). For Study 1's general linear models, an a priori power analyses determined that 60 participants would be sufficient to find a significant ($\alpha = .05$) between-subjects effect with a medium effect size (f2 = .15) and a medium power ($1 - \beta = .8$).

In this between-subjects design, participants were randomly assigned to consider one stimulus item concerning domain condition: Biology (e.g., squid appendage, sea slug's tentacle, inner ear structure, fish's swim bladder, lightning bug's light organ), Artifact (e.g., air intake system, satellite, scuba tank, laser welder, power steering system).

Participants first indicated their task for the survey and then considered 22 statements, presented in pairs, about a single stimulus item. Each pair of statements was presented on its own screen and the order of these pairs was randomized except for Teach First, which came at the end as it was a replication of prior work (McCarthy & Keil, 2023). Participants responded to each statement on a 6-point scale ranging from "This is definitely NOT the case" to "This is definitely the case." For example, a participant in the artifact condition would see the following questions about Magnitudes on the same screen:

> *How strongly do you believe the following statement is true:*
>
> *Just knowing how this [machine] works demonstrates more knowledge than just knowing what this [machine] is for.*
>
> *Just knowing what this [machine] is for demonstrates more knowledge than just knowing how this [machine] works.*

Finally, all participants answered a final attention check question asking them to identify which of 10 stimulus images was their respective stimulus item before lastly providing demographic information and any feedback or comments.

Results and Discussion

Results are displayed in Figure 1. To assess whether participants' judgments differed from chance, 95% bootstrap confidence interval testing was conducted. Then, generalized linear regressions were used to determine whether judgments varied as a function of Domain (factor: 2 levels). For all regressions run, the family was specified as Gaussian. All predictors (i.e., Domain, Age Group, Lesson Condition) were factors, therefore contrast coding was specified for each factor variable to compare each level to chance. Responses were coded as the difference between functional statements to create a single difference score for each category of response.

Magnitude: Participants indicated that knowing just mechanism indicates greater understanding than knowing just function (95% CI [-2.867, -1.900]). Domain significantly predicts responses ($\beta = -0.533$, $p = .029$) where participants in the Biology condition (95% CI [-2.467, -1.200] more strongly believed that mechanism indicated greater knower than participants in the Artifact condition (95% CI [-3.567, -2.267]).

Value (Access): Participants indicated, because it is harder to gain access to mechanistic knowledge, it is more valuable than functional knowledge (95% CI [-1.167, -0.267]). Domain does not predict responses ($\beta = 0.017$, $p = .942$).

[1.517, 2.500]). Domain does not significantly predict responses ($\beta = -0.100$, $p = .696$).

Teach First: Participants indicated teachers should teach function before mechanism (95% CI [1.767, 2.817]). Domain

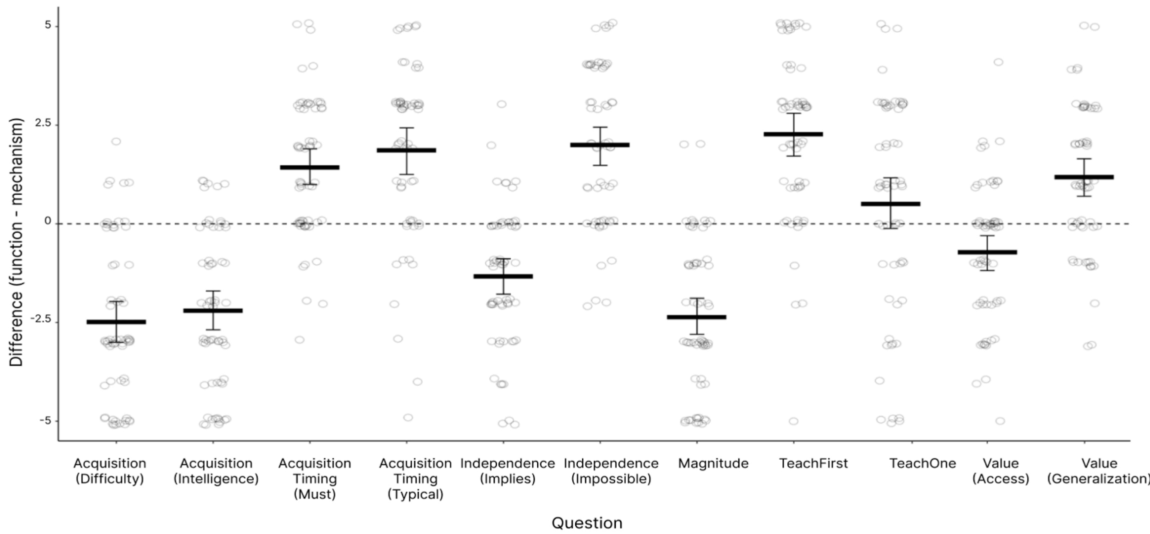

Figure 1: Results from Study 1. Each data point is one response. Difference represents participants responses for mechanism subtracted from their responses for function to create a single difference score. Error bars represent 95% bootstrapped confidence intervals.

Value (Generalizability): Participants indicated that understanding function is more generally applicable than understanding mechanism (95% CI [0.733, 1.650]). Domain does not significantly predict responses ($\beta = 0.150$, $p = .534$).

Acquisition Timing (Typical): Participants indicated a belief that functional knowledge is typically acquired before mechanistic knowledge (95% CI [1.333, 2.433]). Domain does not significantly predict responses ($\beta = 0.367$, $p = .205$).

Acquisition Timing (Must): Participants indicated a belief that functional knowledge typically *must* be acquired before mechanistic (95% CI [0.983, 1.883]). Domain does not significantly predict responses ($\beta = 0.133$, $p = .566$).

Acquisition (Difficulty): Participants indicated it is more difficult to learn and understand mechanism than it is to learn and understand function (95% CI [-2.983, -2.000]). Domain does not significantly predict responses ($\beta = -0.117$, $p = .656$).

Acquisition (Intelligence): Participants indicated that you have to be more intelligent to learn and understand mechanism than you do to learn and understand function (95% CI [-2.700, -1.700]). Domain does not significantly predict responses ($\beta = -0.300$, $p = .246$).

Independence (Implies): Participants indicated knowledge of mechanism implies corresponding functional knowledge more than functional knowledge implies mechanistic knowledge (95% CI [-1.767, -0.883]). Domain does not significantly predict responses ($\beta = -0.300$, $p = .182$).

Independence (Possible): Participants indicated it is more possible to know function without knowing mechanism than to know mechanism without knowing function (95% CI

does not significantly predict responses ($\beta = 0.067$, $p = .807$).

Teach One: Participants indicated no preference if teachers could only teach one, whether they should teach function or mechanism (95% CI [-0.1667, 1.200]). Domain significantly predicts responses ($\beta = -1.000$, $p = .004$) where, in the Biology condition, function was favored (95% CI [0.800, 2.300]) but, in the Artifact condition, participants insignificantly trended toward favoring mechanism (95% CI [-1.533, 0.566]).

Participants in Study 1 were asked to indicate their agreement with a series of statements designed to characterize adults' intuitions of functional and mechanistic knowledge. Results demonstrate that, compared to functional knowledge, mechanistic knowledge is taken as indicating greater understanding, being less accessible, being more difficult to learn and understand, and necessitating greater intelligence to acquire. Participants demonstrated that functional knowledge, on the other hand, was possible to learn absent mechanism, more generally applicable to novel stimuli or situations, and – in line with prior work (McCarthy & Keil, 2023) – should be taught before mechanistic information. Further, participants highlighted a cognitive asymmetry: mechanistic knowledge is believed to imply functional knowledge more so than functional knowledge implies mechanism. Finally, in prioritizing which information type a teacher should teach if they could only teach one, participants in the Artifact condition showed no preference, but trended toward mechanism, while participants in the Biology condition significantly preferred function be taught. Importantly, this finding demonstrates that these measures were sensitive enough to detect potential domain effects, though only one such effect was found.

Study 1's findings suggest that adults have robust and consistent perceptions of functional and mechanistic knowledge. Yet, prior work finds even such strong intuitions may not be accurate (Chuey et al., 2021; McCarthy et al., 2024). Studies 2 and 3 therefore investigate whether these intuitions accurately capture the realities of functional and mechanistic cognition.

Study 2

While Study 1 characterizes the nature of intuitive theories of functional and mechanistic understanding, Study 2 tests learning outcomes from lessons providing functional and mechanistic information in various orders to determine whether, as people expect, (1) mechanism is more difficult to learn and understand than function (*Acquisition (Difficulty)*), (2) lessons should provide function before mechanism in an explanation (*Teach First*), and (3) if functional knowledge must be acquired before mechanistic knowledge (*Acquisition Timing (Must)*). While the methods of this study closely resemble work considering whether intuitions that function should precede mechanism in an explanation (McCarthy & Keil, 2023) reflect variations in learning outcomes (McCarthy et al., 2024), the analyses conducted here will be able to speak to a broader array of intuitions of functional and mechanistic knowledge and learning.

Here, adult participants will be assigned to either a $\text{Control}_{\text{No Lesson}}$ condition, a Function-first (i.e., function-then-mechanism) lesson condition, or a Mechanism-first (i.e., mechanism-then-function) lesson condition where they will be introduced to their respective stimulus item before answering a series of 6 questions probing for resulting functional (3 questions) and mechanistic (3 questions) understanding of the stimulus. As in Study 1, Study 2 considers the breadth of potential outcomes by investigating both artifacts (laser welder, power steering system) and biological parts (lightning bug's light organ, fish's swim bladder).

If mechanism is more difficult to learn than function as adults' intuitions suggest (*Acquisition (Difficulty)*), then learners should perform worse on questions of mechanistic understanding than on questions of functional understanding after their respective lesson. Likewise, if functional knowledge *must* be acquired before mechanism (*Acquisition Timing (Must)*), then participants in the Function-first condition should perform better on both functional and mechanistic measures. If functional knowledge should be presented before mechanism as adults expect (*Teach First*), we might similarly expect to find a lesson effect where Function-first participants outperform Mechanism-first participants.

Method

Ninety-six adult participants participated in a survey on Prolific. For Study 2's general linear models, an a priori power analyses determined that 96 participants would be sufficient to find a significant (α = .05) between-subjects effect with a medium effect size (f2 = .15) and a medium power (1 – β = .8). 18 participants were excluded and replaced for either failing to identify their task prior to participation (14), failing to identify which of two characters was an expert (1), or failing to identify what stimulus item they had answered questions about (3).

Participants were randomly assigned to consider 1 of 4 potential stimulus items that were either a biological part (e.g., fish's swim bladder, lightning bug's light organ), or an artifact (e.g., laser welder, power steering system). Participants were assigned to one of three lesson conditions ($\text{Control}_{\text{No Lesson}}$, Mechanism-first, Function-first). Participants in the mechanism-first and function-first conditions were asked to read explanations that each consisted of two parts, shown on separate screens, which participants were only allowed to move forward through with either function or mechanism first depending on condition. Participants in the control-No Lesson condition did not see a lesson before answering dependent measures.

After being introduced to the task, participants were asked to correctly identify which of the 7 multiple choice options correctly identified their task for this study. Next, participants in the lesson conditions saw their lessons, accompanied by still images of their respective stimulus item, and split according to information type across two screens. "Expert" was then defined for participants who were then required to correctly identify a character who "has seen this thing before and has read a few different books about it" as an expert over a character who "has never seen this thing before and knows nothing about it." As pre-registered, anyone who failed to correctly answer this question was excluded from subsequent data analyses.

Next, participants were presented with 6 4-option multiple choice questions presented in a randomized order with answer choices likewise randomized: 3 questions about the function of the stimulus item, and 3 questions about the mechanism of the stimulus item. Finally, participants were asked to identify which of the 10 images was the stimulus item they were asked questions about before answering demographic questions and having an opportunity to provide feedback.

Results and Discussion

Results can be seen in Figure 2. To assess whether participants' performance differed from chance, 95% bootstrap confidence interval testing was conducted. Then, generalized linear regressions were used to determine whether performance varied as a function of 'Taught' (i.e., whether participants received a lesson or not; factor: 2 levels), Lesson (factor: 3 levels), Domain (factor: 2 levels), or any interaction between these variables. Independent regressions predicted the sum of function scores and sum of mechanism scores.

The Function model revealed that participants who received a lesson (M_{Taught} = 2.828) performed significantly better on Function measures than did participants who did not receive a lesson (M_{Control} = 1.063; β = -0.906, $p <$ .001).

However, the kind of lesson that participants received did not influence performance (β = -0.031, p = .875), nor did Domain (β = -0.063, p = .528). Further, even when considering only participants who received a lesson and collapsing across Domain, the Lesson condition (β = 0.016, p = .801) does not predict Functional learning outcomes.

The Mechanism model revealed that participants who received a lesson (M_{Taught} = 2.156) performed significantly better on Mechanism measures than did participants who did not receive a lesson ($M_{Control}$ = 1.094; β = -0.906, p < .001). Domain also predicts performance where participants in the Biology condition ($M_{Biology}$ = 2.063) did better on questions of mechanism than participants in the Artifact condition ($M_{Artifact}$ = 1.542; β = -0.250, p = .020), though there are no significant interactions with Domain. As for questions of Function, the kind of lesson that participants received does not significantly influence performance on questions of Mechanism (β = 0.375, p = .078). Further, even when considering only participants who received a lesson and collapsing across Domain, the Lesson condition (β = -0.188, p = .061) marginally predicts Mechanistic learning outcomes.

Participants in the $Control_{No\ Lesson}$ condition were at chance (.75) on both measures of Function (95% CI [0.656, 1.438]) and measures of Mechanism (95% CI [0.719, 1.438]).

Participants in the Function-first condition were significantly above chance on measures of Function (95% CI [2.688, 3.062]) as well as measures of Mechanism (95% CI [1.688, 2.250]).

Participants in the Mechanism-first condition were significantly above chance both on measures of Function (95% CI [2.688, 2.969]) and on measures of Mechanism (95% CI [2.094, 2.625]).

Participants who received a lesson did better on Function measures (95% CI [2.719, 2.953]) than on Mechanism measures (95% CI [1.969, 2.344]; t = 5.724, p < .001).

Participants in Study 1 indicated beliefs that (1) mechanism is more difficult to learn and understand than function, (2) lessons should provide function before mechanism in an explanation, and (3) functional knowledge typically *must* be acquired before mechanistic knowledge. Study 2's learning outcomes demonstrate whether these intuitions reflect norms of learning and understanding functional and mechanistic information.

Study 2 is consistent with prior literature (McCarthy et al., 2024), yet inconsistent with adults' intuitions (*Teach First*; *Acquisition Timing (Must)*), explanations do not need to provide functional information first to confer benefits to learners. Participants who received a lesson outperformed participants who did not receive a lesson on both Functional and Mechanistic outcome measures, yet there was no difference between participants who received functional information first and those who received mechanistic information first.

Participants who had an opportunity to learn about the function and mechanism of their respective stimulus item performed significantly better on functional questions than on mechanism questions, suggesting that, in line with adults' intuitions (*Acquisition (Difficulty)*), mechanism is more difficult to learn than function.

Study 2 provides insight into some of the intuitions that adults hold regarding function, mechanism, and their relation, suggesting that intuitions about Acquisition Difficulty are accurate, but those concerning Acquisition Timing are not. However, this study is limited in that adults in the Function-first and Mechanism-first conditions saw *both* information types, leaving us without insight into whether, for example, mechanistic knowledge fosters functional understanding.

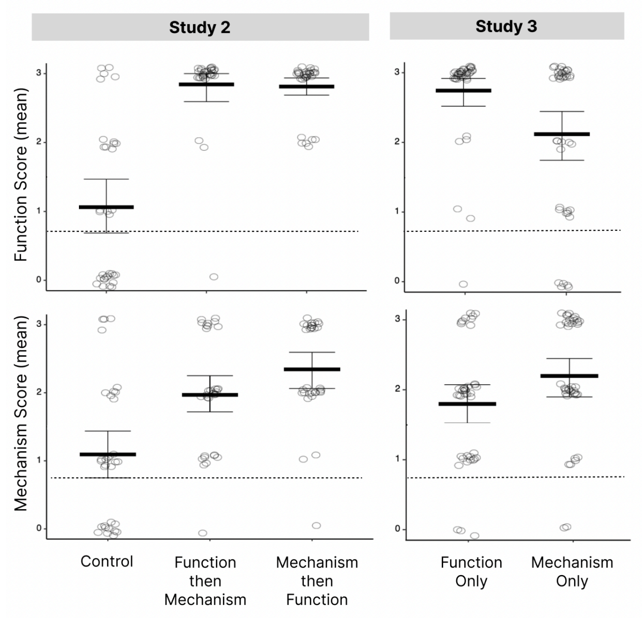

Figure 2: Results from Studies 2 and 3.

Study 3

Study 3 further investigates the potential pedagogical bases for intuitions established in Study 1 by teaching adults just one information type to consider whether it is possible to learn mechanism without having learned function (*Independence (Possible*)). By teaching only function or mechanism, Study 3 considers whether understanding mechanism affords corresponding functional knowledge (*Independence (Implies)*). Further, Study 3 revisits whether mechanism is more difficult to learn than function (*Acquisition (Difficulty)*) as well as if there is a basis for the general non-preference in whether teachers teach only function or only mechanism to students (*Teach One*).

Method

Study 3 paralleled Study 2's methods except participants were shown either function (Function-only condition) or mechanism (Mechanism-only), and there was no $Control_{No\ Lesson}$ as it would have been redundant.

Eighty adults participated via Prolific. For Study 3's general linear models, an a priori power analyses determined that 80 participants would be sufficient to find a significant (α = .05) between-subjects effect with a medium effect size

($f2 = .15$) and a medium power ($1 - \beta = .8$). 16 participants were excluded and replaced for either failing to identify their task prior to participation (14) or failing to identify what stimulus item they had answered questions about (2).

To prevent dependent measures from incidentally providing information from the opposite condition prior to aligned measures being complete, participants answered all aligned questions prior to answering the other type of questions. Within each type, questions were randomized. For example, a participant in the Function-only condition would answer all 3 function questions before answering all 3 mechanism questions.

Results and Discussion

Results can be seen in Figure 2. Analyses followed the procedure of Study 2 aside from considering the 'Taught' variable, as all participants received a lesson.

The Function model revealed that participants who learned about Function ($M_{\text{Function only}} = 2.750$) performed significantly better on Function measures than participants who received only a Mechanism lesson ($M_{\text{Mechanism only}} = 2.125$; $\beta = 0.313, p = .003$). Domain did not moderate performance ($\beta = 0.088, p = .396$).

The Mechanism model revealed that participants who learned about Mechanism ($M_{\text{Mechanism only}} = 2.344$) performed significantly better on Mechanism measures than did participants who received a Function lesson ($M_{\text{Function only}} = 1.969$; $\beta = -0.200, p = .041$). Domain did not mediate performance ($\beta = -0.175, p = .073$).

Participants in the Function-only condition were significantly above chance (.75) on measures of Function (95% CI [2.575, 2.975]) as well as measures of Mechanism (95% CI [1.525, 2.075]).

Participants in the Mechanism-first condition were significantly above chance both on measures of Function (95% CI [1.800, 2.475]) and on measures of Mechanism (95% CI [1.950, 2.475]).

Participants in the Function-only condition did better on function measures (95% CI [2.575, 2.975]) than on Mechanism-only participants did on mechanism measures (95% CI [1.950, 2.475]; $t = 3.206, p = .002$).

Participants in Study 3 were taught only one information type before being tested on both functional and mechanistic understanding. For both Function-only participants and Mechanism-only participants, performance was above chance on measures of both functional knowledge and mechanistic knowledge, suggesting that adults' non-preference for which information type to teach if only one was taught (*Teach One*) reflects learning outcomes: Independent of lesson condition, participants were able to accurately learn both function and mechanism. Adults believe that learning function without mechanism is easier than learning mechanism without function (*Independence (Possible)*), yet participants in both Function-only and Mechanism-only conditions were above chance on outcome measures of both types, suggesting it is quite possible to learn either information type without the other.

Study 1 demonstrates that adults believe mechanistic knowledge suggests functional understanding in a way that functional knowledge does not imply mechanistic understanding (*Independence (Implies)*). However, while Mechanism-only participants performed above chance on functional questions, Function-only participants likewise performed above chance on mechanism questions. Therefore, while functional information can be inferred from mechanistic information, so too can mechanistic information be successfully inferred from functional information.

Consistent with Studies 1 and 2's findings, Function-only participants in Study 3 performed better on function questions than Mechanism-only participants performed on mechanism questions; mechanism is more difficult to learn than function (*Acquisition (Difficulty)*).

General Discussion

Study 1 demonstrates that adults believe function is a more accessible knowledge type that should be taught first and can be acquired on its own. Mechanism, on the other hand, is considered a knowledge type of greater magnitude that is also more difficult to learn and understand, and more valuable in that it is more difficult to gain access to.

Studies 2 and 3 then demonstrates that some, but not all, of adult intuitions capture truths of functional and mechanistic cognition. Adults accurately intuit that mechanism is more difficult to learn than function, but their strong intuitions that mechanistic knowledge implies functional knowledge, for example, overstate trends in the data. Further, beliefs that function, but not mechanism, can be learned independently or that function typically must be learned before mechanism are patently untrue, at least in the case of adult learning.

During lessons participants across conditions were presented with context-providing images and/or diagrams of the stimulus items. While these images were not sufficient in teaching participants on their own, in combination with a verbal explanation these images may have incidentally provided functional and mechanistic information, making the verbal contrasts between the information types less precise.

The use of unnamed and relatively unfamiliar artifacts and biological parts illustrates in adults how a child might encounter novel entities. However, adults rarely encounter, for example, the cellular structure of an animal without at least knowing what kind of animal is being considered. An image of a familiar artifact, such as a light bulb, or knowing that the biological part in question was from a lightning bug might drastically shift both intuitions and learning outcomes.

Finally, Study 1 juxtaposes functional and mechanistic statements, potentially creating a forced contrast that adults do not otherwise make intuitively. Future work might consider how spontaneous explanatory structure, for example, captures intuitive models of pedagogical best practices and epistemic inferences.

In conclusion, adults' epistemic inferences are strong, but largely inaccurate in capturing the nature of functional and mechanistic cognition.

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