How do the semantic properties of visual explanations guide causal inference?

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Questions

- *What distinguishes **visual explanations** that explain how novel mechanical systems work from drawings that depict how those same systems look?*

- *How do the semantic properties of visual explanations guide how naive viewers use them?*

Procedure

1 **Experimental manipulation of communicative goals**

Obtained dataset of 150 visual explanations + 150 depictions machines
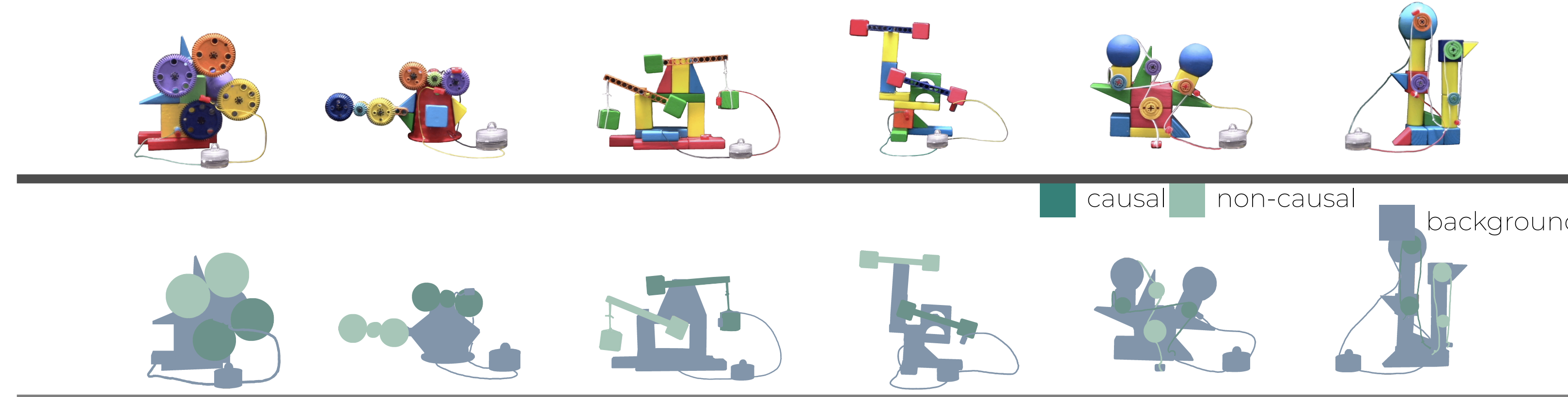
Half the mechanical elements were causal (i.e., activate light bulb); half were not

Crowdsourced semantic annotations of how each stroke in the drawings corresponded to the different parts of the machines

2 **Evaluation of functional value of drawings for downstream tasks**

2.1, Naive viewers identified which machine each drawing represented; 2.2, identified which element to intervene on; and 2.3, how to intervene on the machines to produce an effect
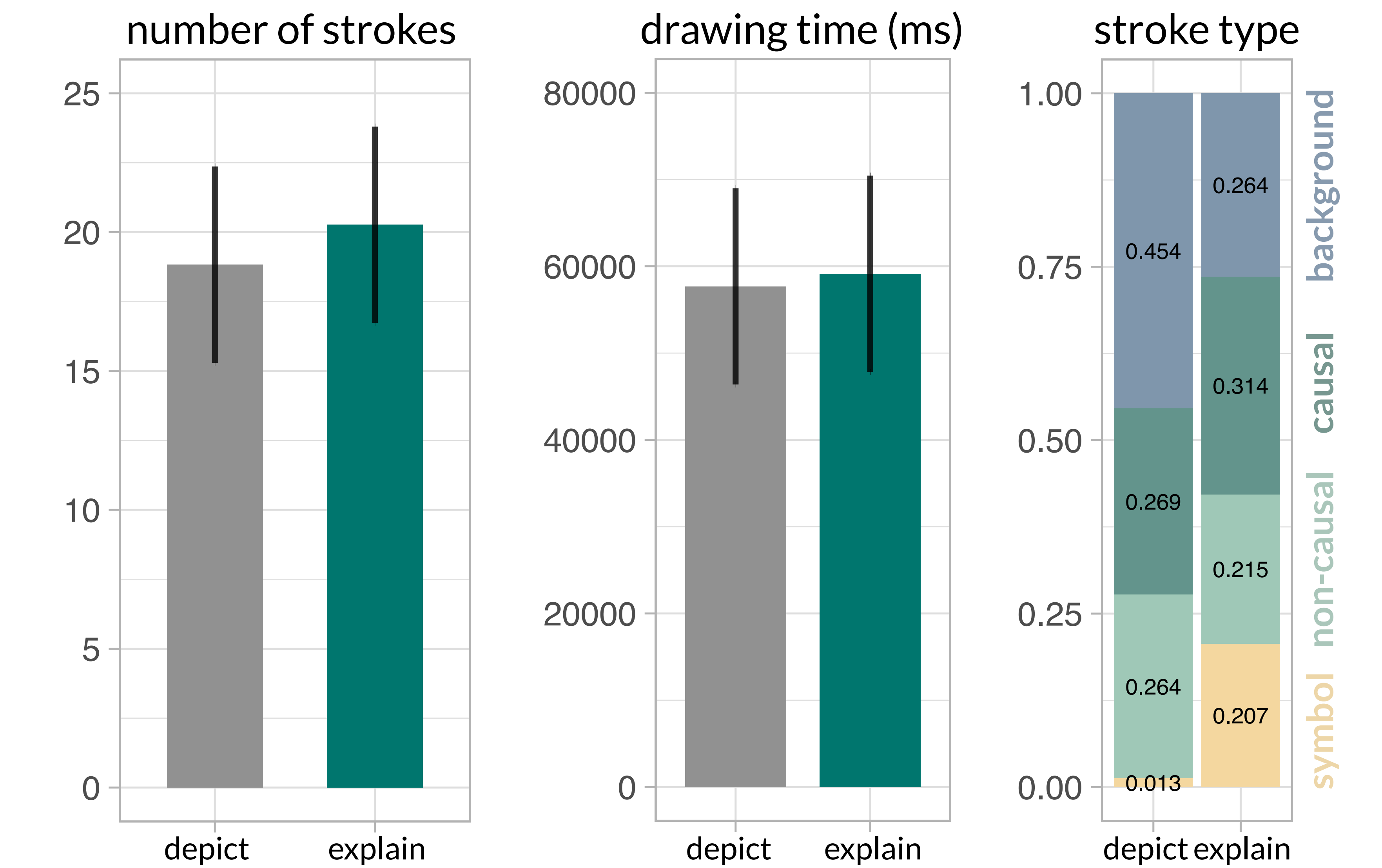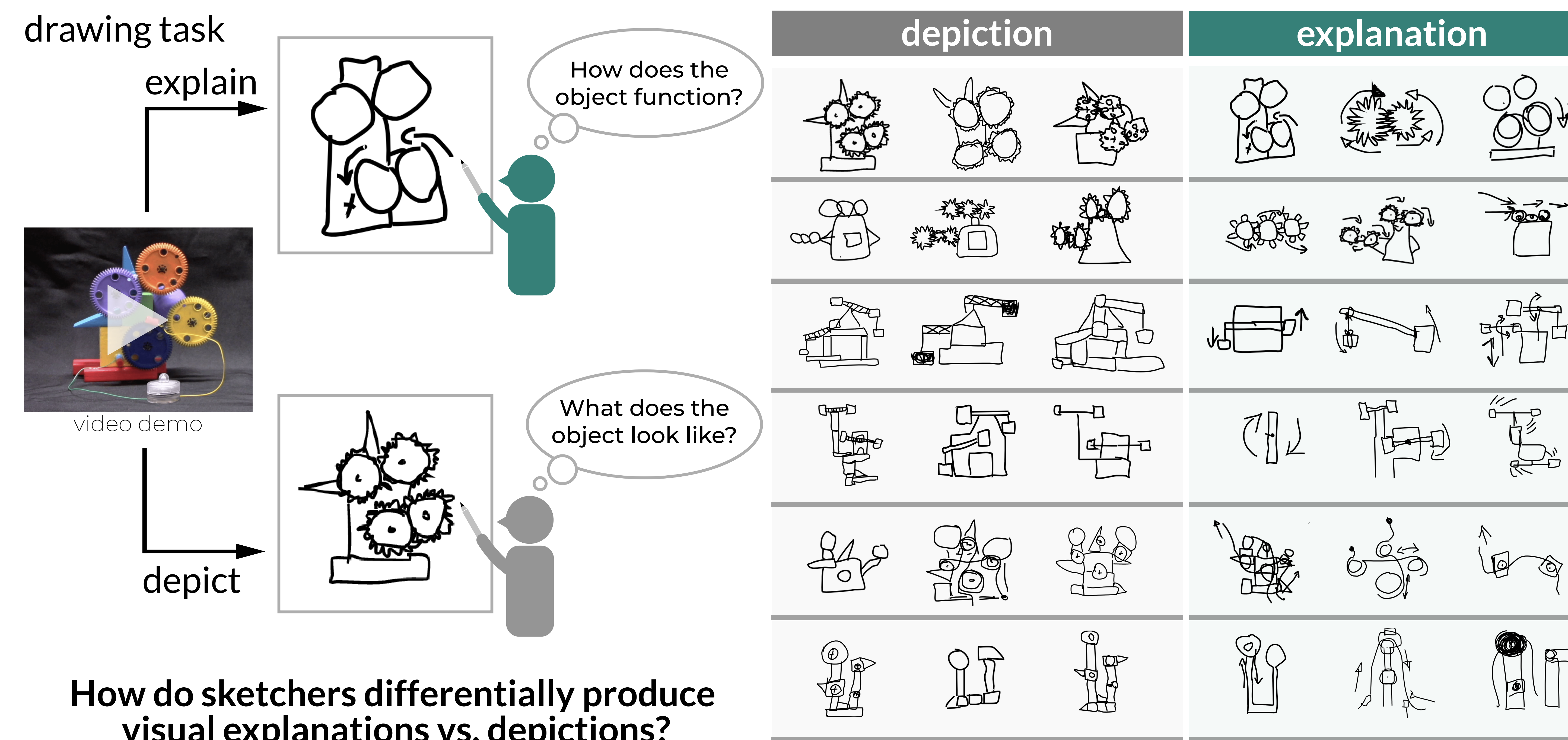
Discussion

Goal to convey causal knowledge systematically shifts drawings toward more abstract, functional information.

Visual explanations are more successful at conveying the *kind* of action to take than which element to intervene on in a mechanical system.
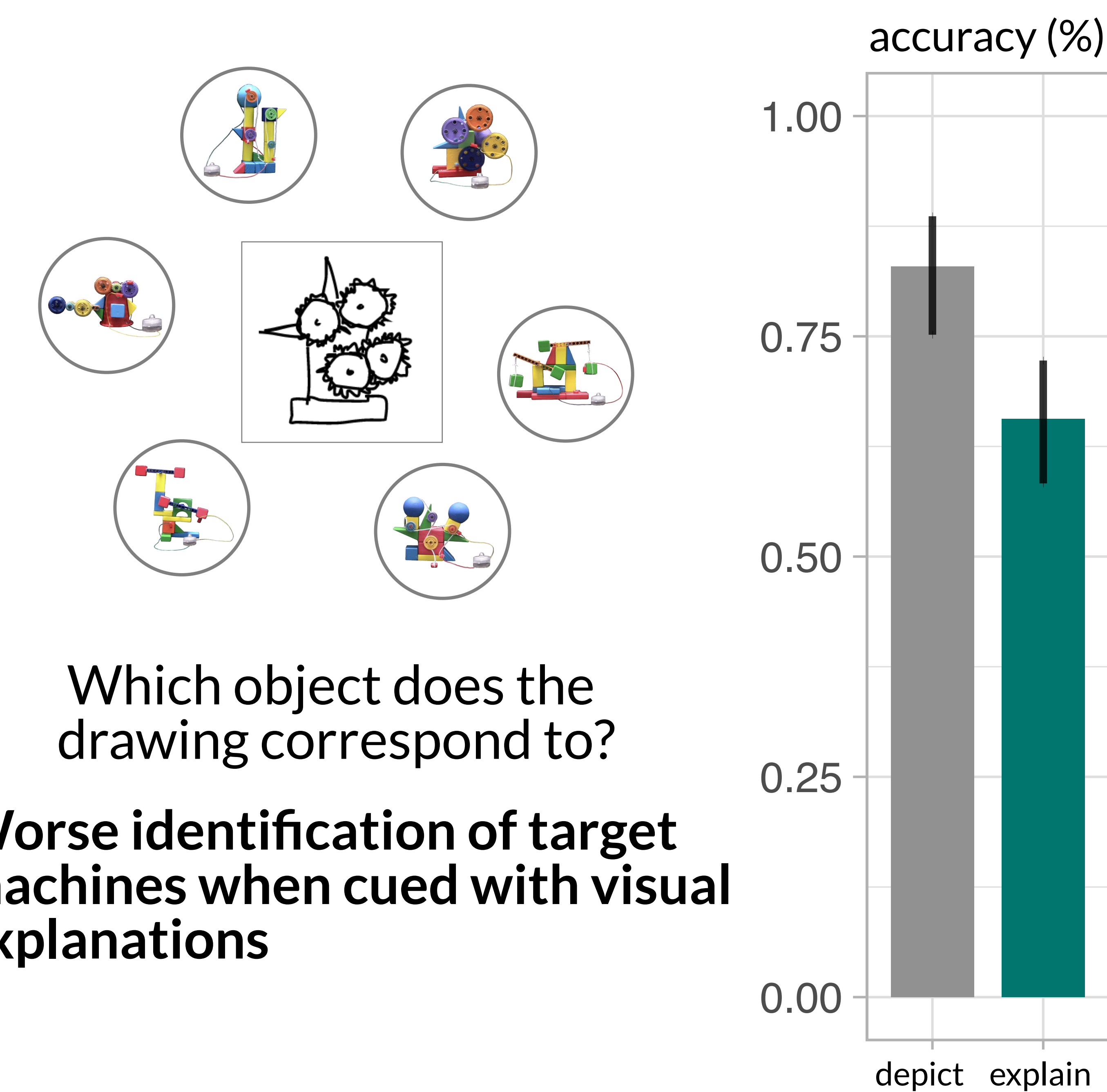
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1 Visual Production Behavior

drawing task

explain — *How does the object function?*

video demo

depict — *What does the object look like?*

How do sketchers differentially produce visual explanations vs. depictions?

depiction	explanation

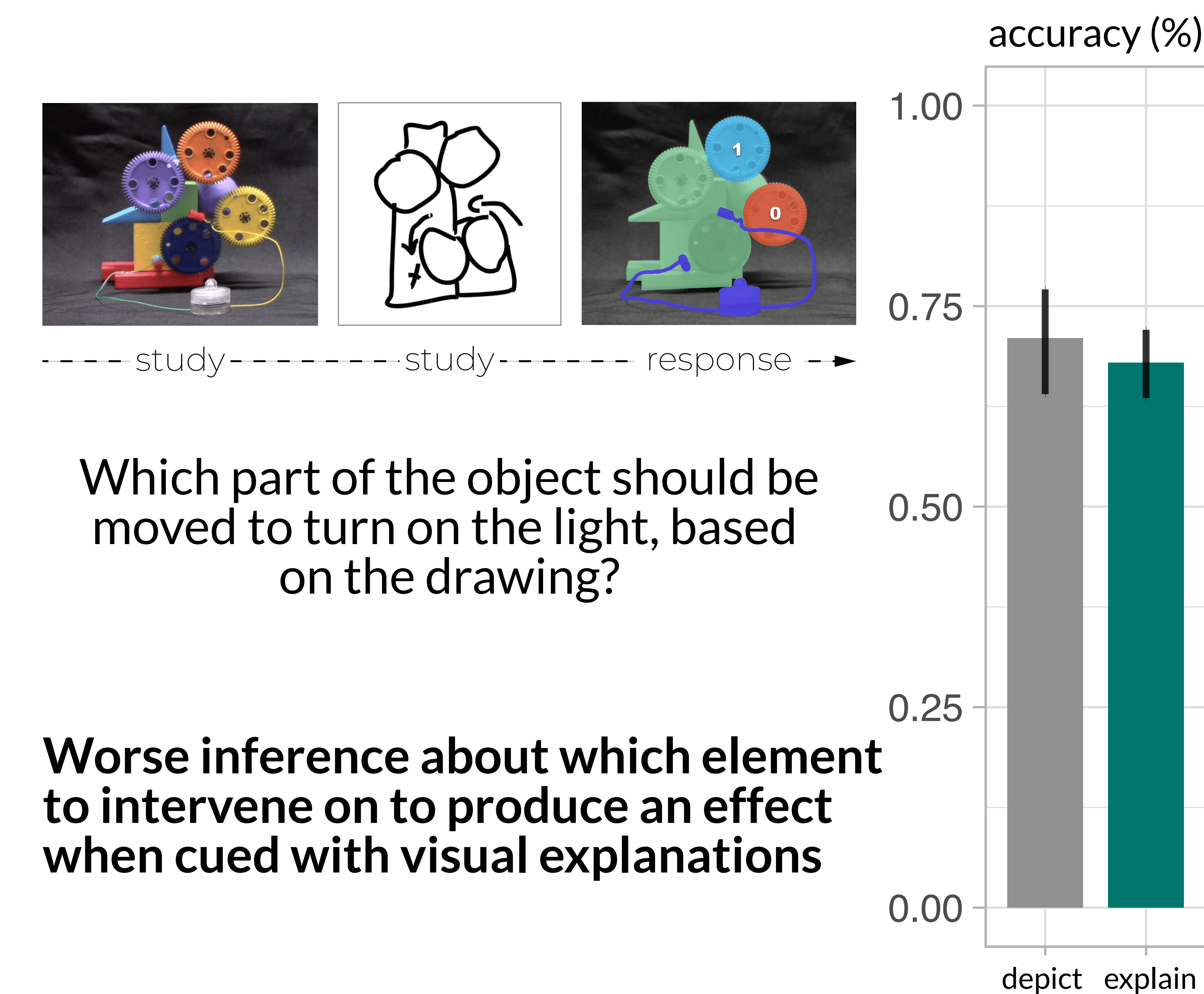number of strokes / drawing time (ms) / stroke type

Similar number of strokes & amount of drawing time

Visual explanations emphasized causal features & symbols, but at an expense to structural features

2.1 Object Identification

Which object does the drawing correspond to?

accuracy (%)

Worse identification of target machines when cued with visual explanations

2.2 Causal Inference

study — study — response

Which part of the object should be moved to turn on the light, based on the drawing?

accuracy (%)

Worse inference about which element to intervene on to produce an effect when cued with visual explanations

2.3 Causal Intervention

Pull | Rotate | Push | I don't know

What intervention is needed to operate the object, based on the drawing?

accuracy (%)

Better inference about which action is needed to operate the machines when cued with visual explanations

*this recent work is not included in CogSci paper