

DOES COGNITIVE LOAD INFLUENCE FLEXIBILITY ?

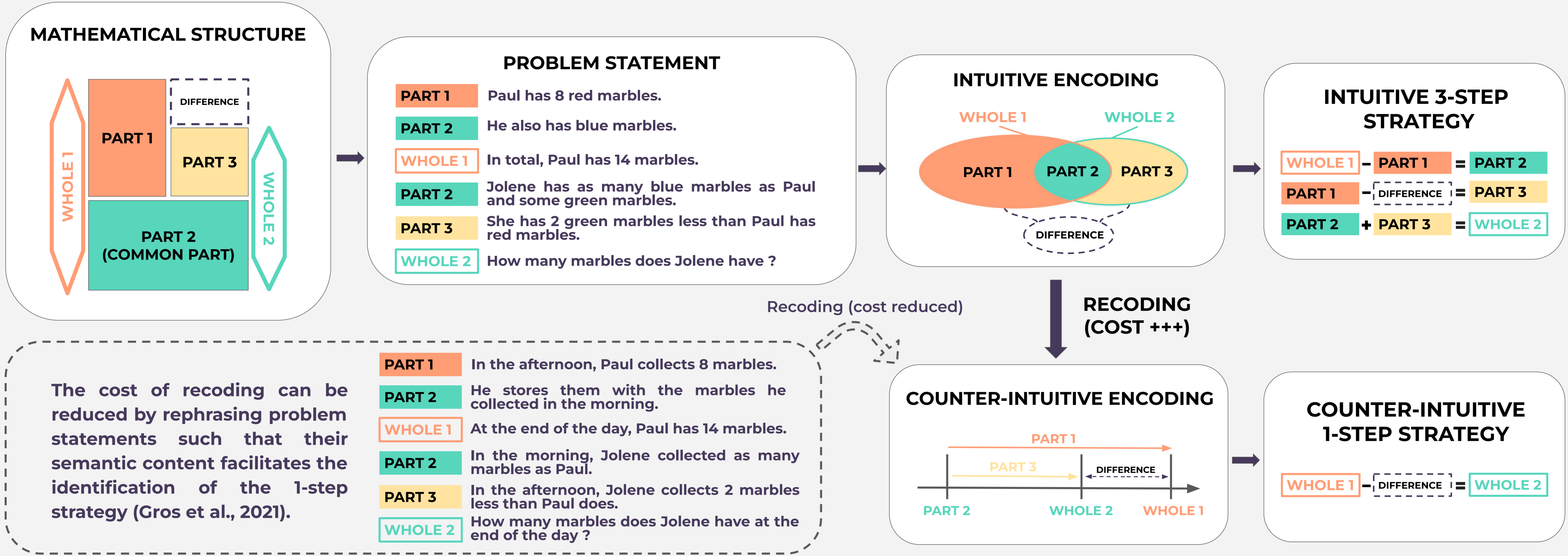
A study of arithmetic reasoning among children and adults.

Maelle Dagnogo^{1,2}, Evelyne Clément¹, & Hippolyte Gros¹

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Finding the optimal solving strategy to an arithmetic word problem sometimes requires switching point of view on the problem's situation, by means of **semantic recoding**. Such ability, which relies on **cognitive flexibility** (Clément, 2022), is cognitively costly (Gros et al., 2019) and yet crucial in developing learners' mastery of problem solving. According to **Cognitive Load Theory** (Sweller et al., 2019), learners' performances on a task may be affected by the amount of executive resources available to them for that task. Using arithmetic problems whose most efficient solving strategy is counterintuitive and calls for a perspective change – as described in the diagram below – we investigated whether variations of intrinsic and extraneous cognitive loads affected adults' and children's ability to be flexible and perform semantic recoding when solving mathematical word problems.



Does an increase in cognitive load affect participants' ability to use the counterintuitive 1-step strategy to solve the problems? Is this effect modulated by the cost of the recoding associated with a problem statement?

EXPERIMENT 1 - INTRINSIC LOAD

Participants : 43 adults (M = 21.15 y, SD = 1.83 y) & 62 4th-5th graders (M = 10.24 y, SD = 0.67 y)

Design : Series of 12 problems presented on paper booklets

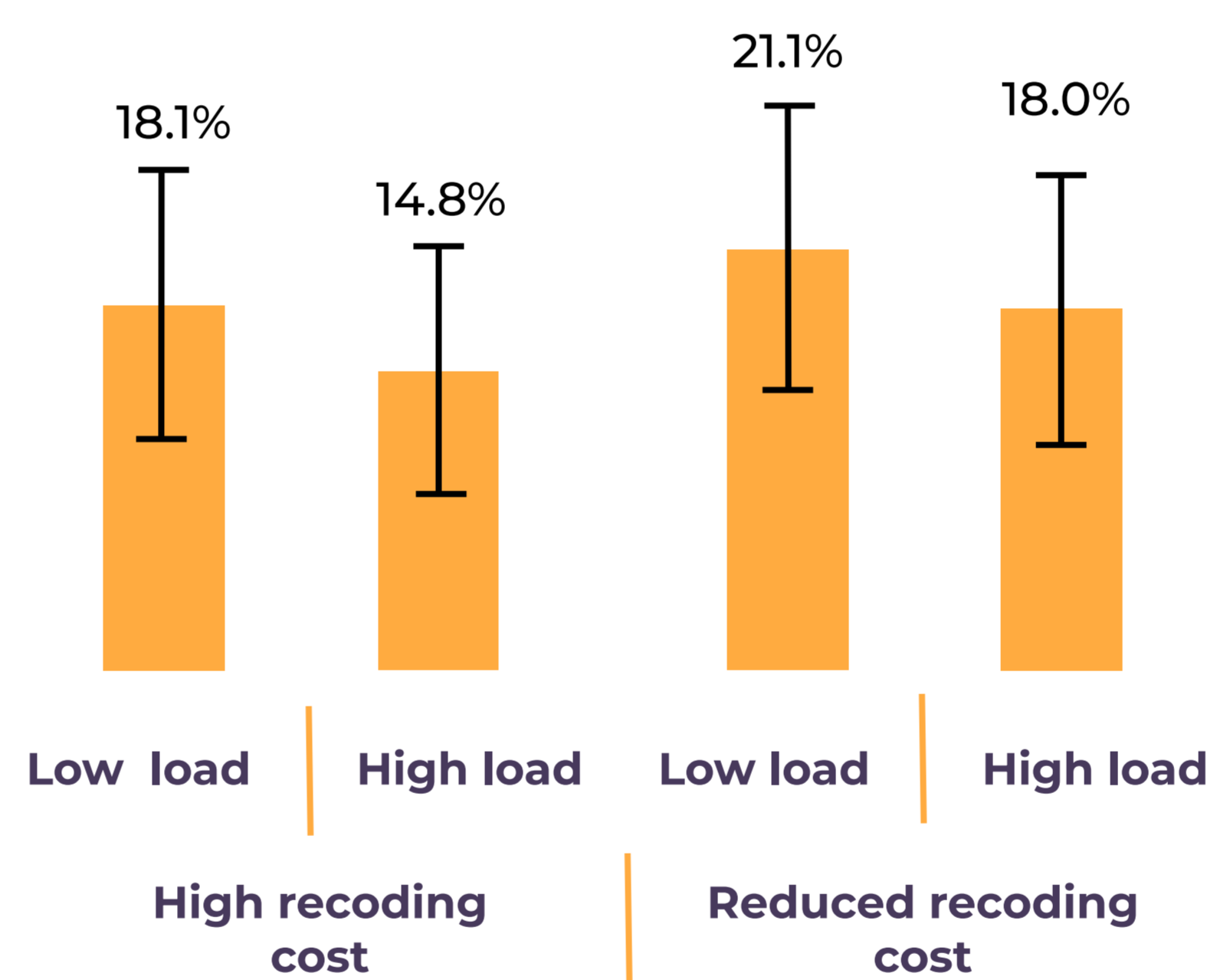
- 6 problems with high cost of recoding
- 6 problems with reduced cost of recoding

Instructions : "Solve the problems using as few operations as possible"

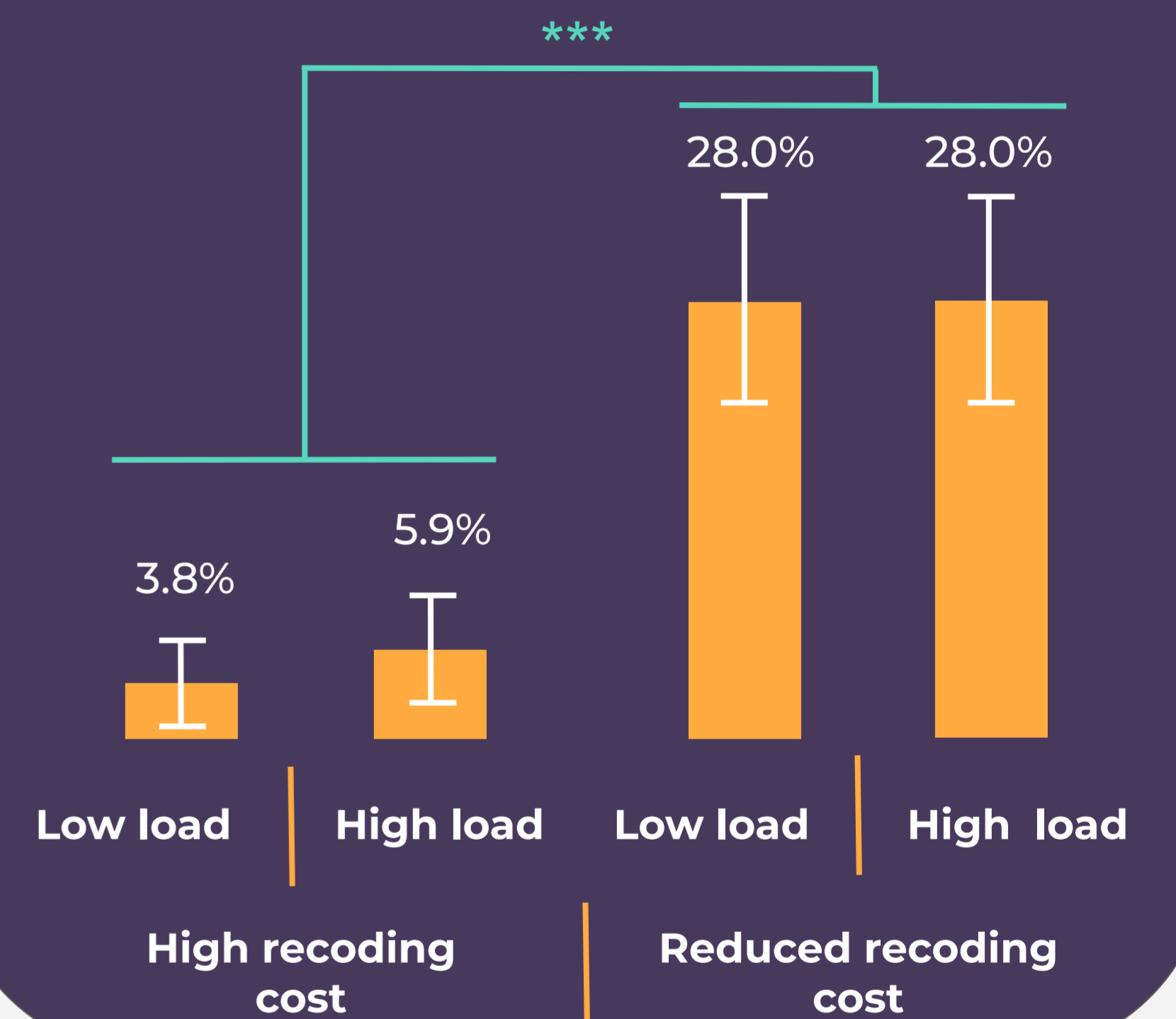
Load manipulation : variation of numerical values

- Low load condition : 1-digit values (e.g., (7, 9, 3)) for children, 2-digit values for adults (e.g., 63, 82, 37)
- High load condition : 2-digit values for children, 3-digit values for adults (e.g., 251, 460, 122)

Rate of use of the 1-step strategy



Rate of use of the 1-step strategy



ADULTS

CHILDREN

EXPERIMENT 2 - EXTRANEIOUS LOAD

Participants : 33 adults (M = 21.55 y, SD = 2.61 y) & 62 4th-5th graders (M = 10.46 y, SD = 0.63 y)

Design : Series of 12 problems presented on paper booklets

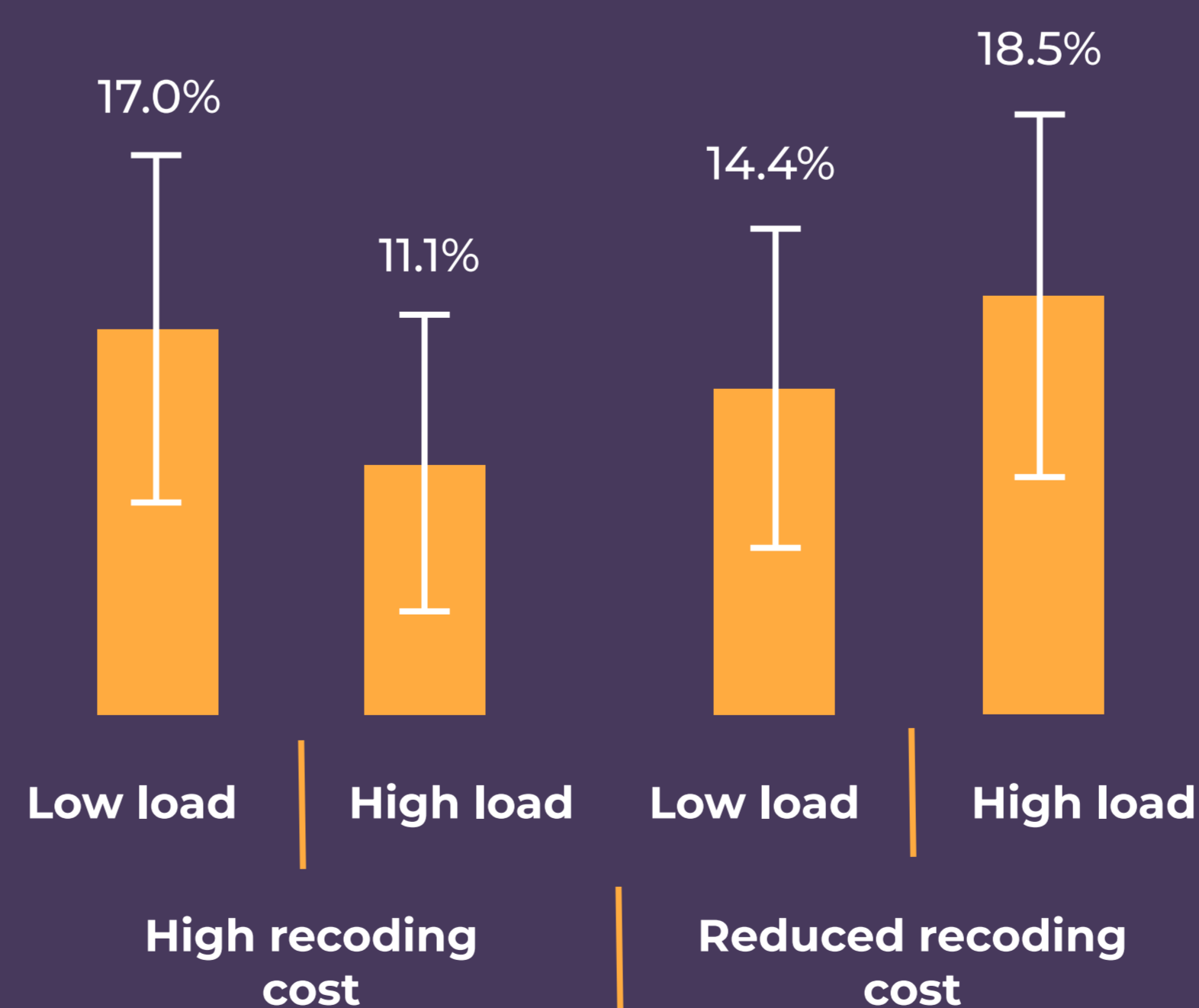
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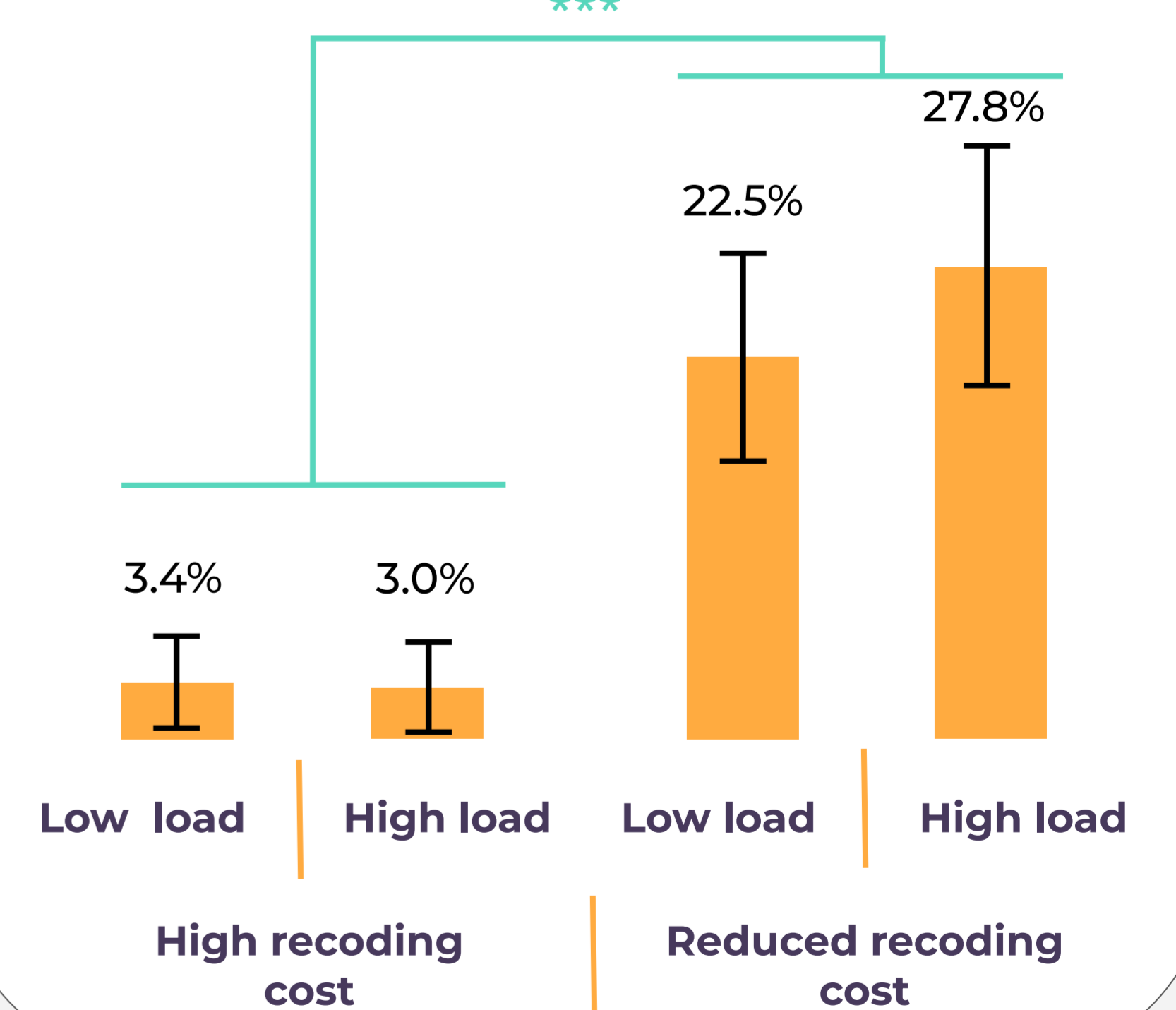
Load manipulation : Double task paradigm including a dot memory task (when failed, trial was removed from analyses)



Rate of use of the 1-step strategy



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GENERAL DISCUSSION

Our analyses showed no effects of cognitive load on participants' ability to perform semantic recoding. We argue this might be explained by an inadequate manipulation of load, as suggested by performance rates (i.e., rates of problems correctly solved, regardless of the strategy used) which do not differ significantly between load conditions in any of the groups or experiments. Interestingly, our results in adults do not replicate the effect of recoding cost found by Gros et al. (2021), which may reveal other limitations of the experimental design.



Acknowledgments - This research is part of an ongoing project in collaboration with the University of Geneva (Katarina Gvozdic, Emmanuel Sander), the University of Montpellier (André Tricot) and the University of Nîmes (Florence Lespiau). This project is funded by a research grant (CYIn-AAP2021-AmbEm-000000026) attributed to Hippolyte Gros by CY Initiative.

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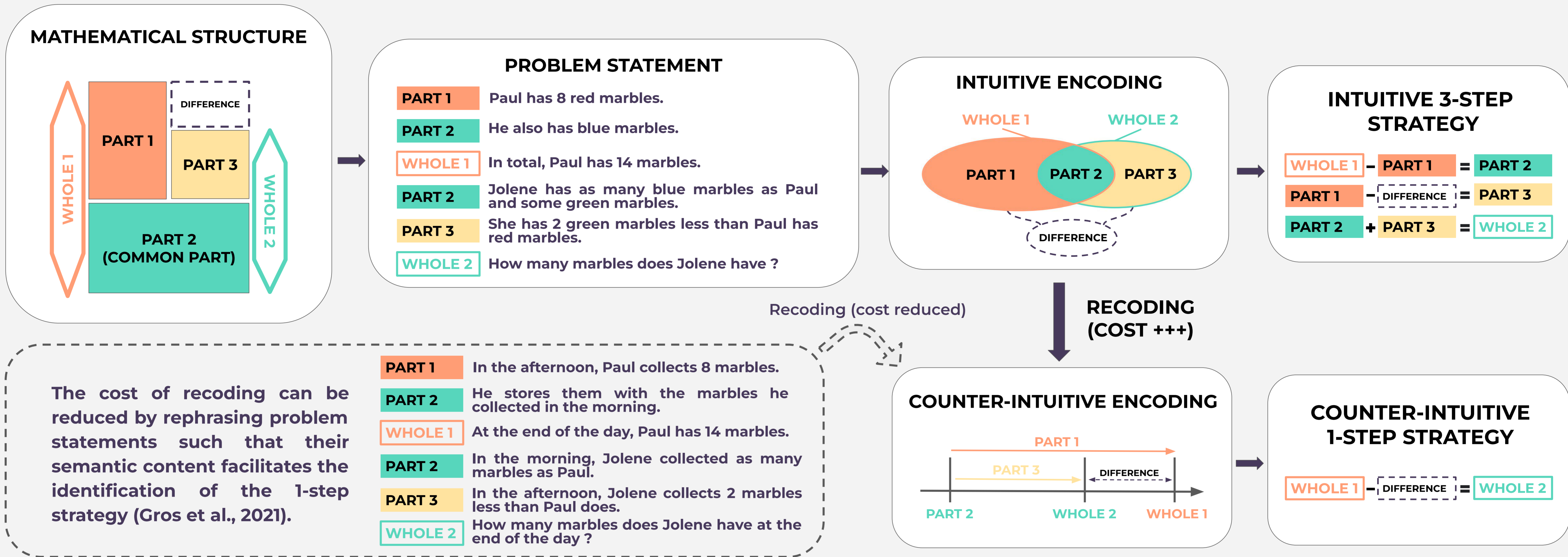
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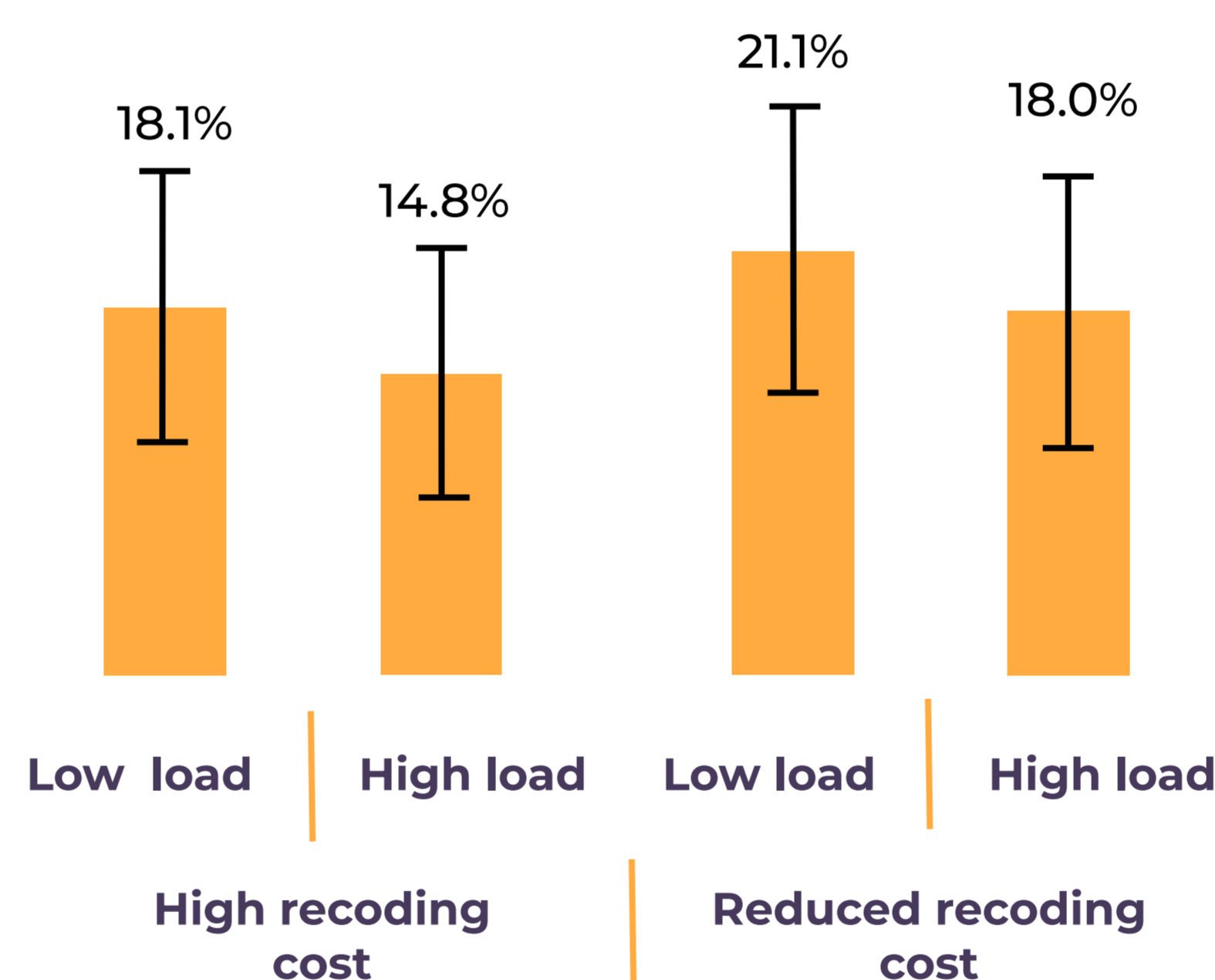
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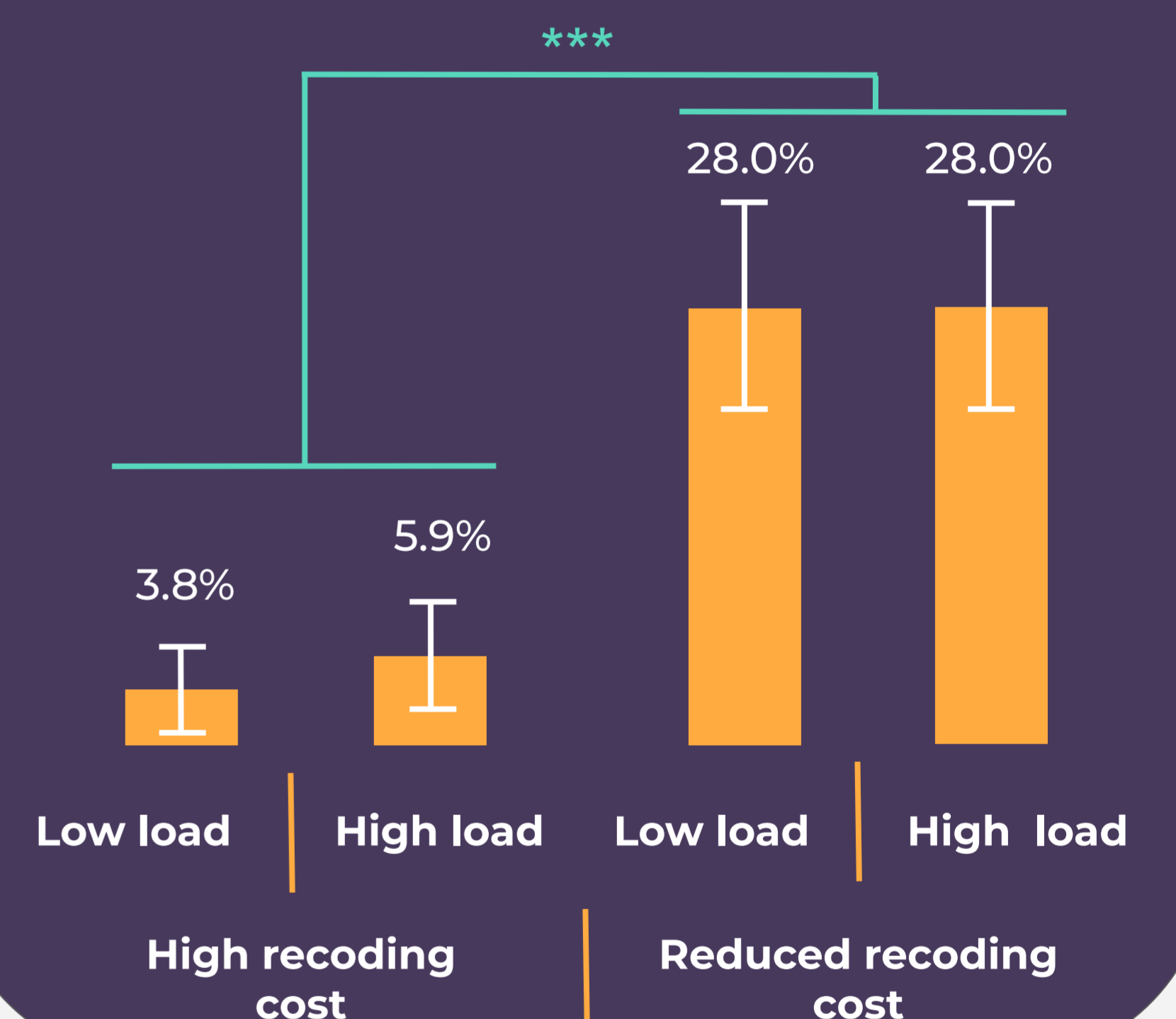
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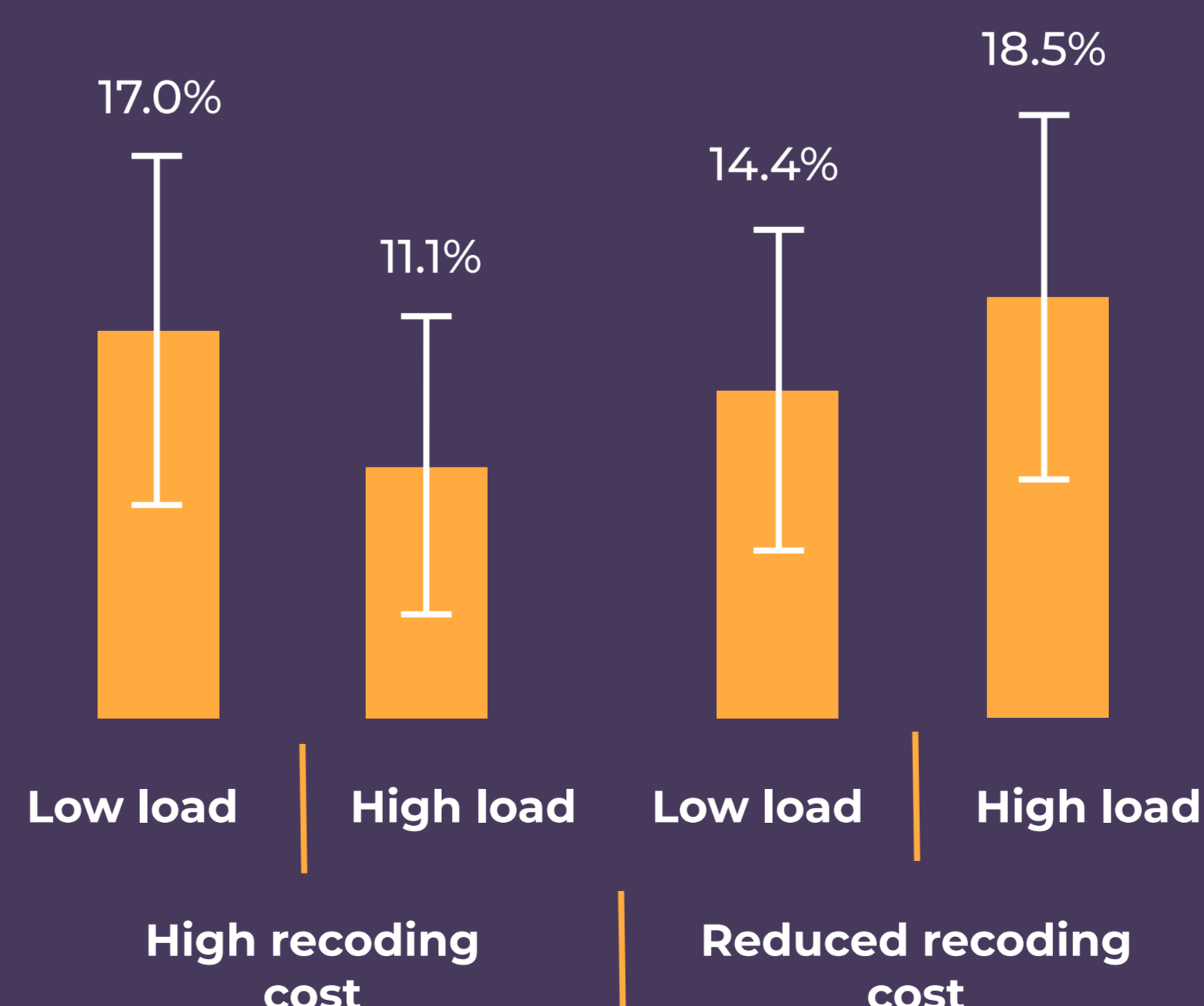
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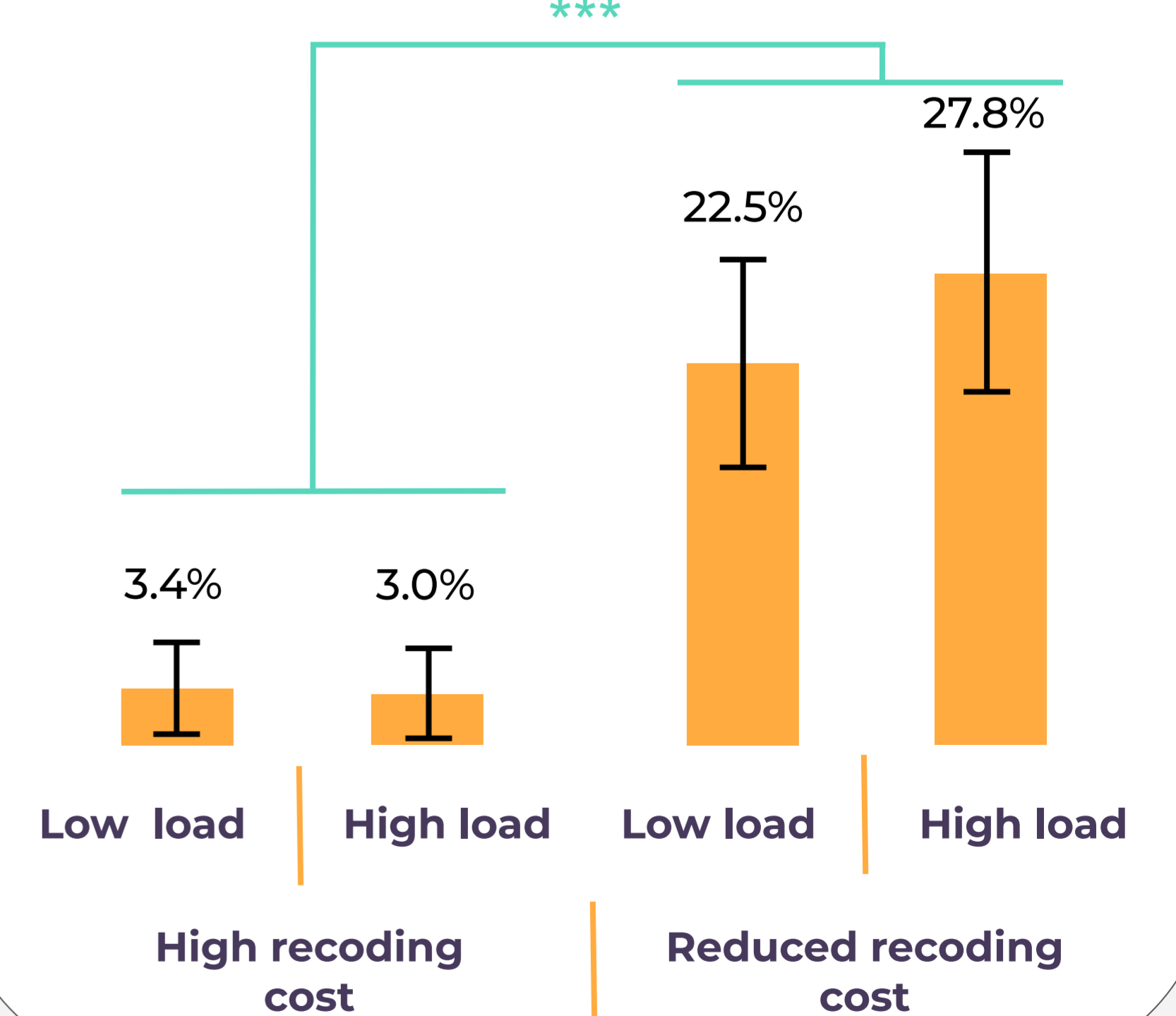
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