Embodied Rigidity: How Physical Flexibility Shapes Memory for Metaphorically Aligned Behaviors

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Abstract. Embodiment research suggests that bodily traits shape abstract thought, yet existing studies mainly focused on lateral asymmetries like handedness. This study investigates whether physical flexibility influences memory for metaphorically aligned behaviors, as suggested by linguistic metaphors (e.g., "flexible thinking"). Drawing on the Body Specificity Hypothesis and Conceptual Metaphor Theory, we hypothesize that memory performance will be enhanced when a participant's bodily state (high or low flexibility) aligns with the metaphorical content of a behavior (flexible or rigid). Sixty adults, pre-screened for high or low physical flexibility, will complete a cognitive flexibility task. We predict a significant interaction: high-flexibility participants will recall more from flexible-behavior patterns, while low-flexibility participants will recall more from rigid-behavior patterns. This would extend embodiment theory beyond lateral asymmetries and link it to schema-congruence in memory.

Keywords: Physical Flexibility, Memory, Body Specificity Hypothesis.

1. Introduction

Over the past two decades, embodiment research has highlighted the role of the body in shaping abstract thought [1]. The Body Specificity Hypothesis (BSH), proposed by Casasanto [2], argues that stable bodily traits such as handedness influence how people represent and process concepts, with consequences for emotion, memory, and decision-making. Complementing this view, Conceptual Metaphor Theory [3] emphasizes that abstract concepts are grounded in sensorimotor experiences. Together, these frameworks suggest that individual differences in the body contribute to systematic variations in cognition.

Although this perspective has generated a wide body of evidence, research has disproportionately focused on lateral asymmetries such as handedness and footedness, leaving other bodily traits largely unexplored. In particular, physical flexibility—the degree to which the body can bend or stretch—has not been systematically linked to cognitive processes. Yet metaphors in everyday language strongly associate flexibility of the body with flexibility of the mind, as in expressions such as "bend the rules," "flexible thinking," or conversely "rigid beliefs" [4]. Such linguistic

metaphors imply that bodily flexibility could serve as a concrete source domain for abstract schemas of adaptability versus rigidity.

Memory research also provides a useful lens for investigating this relationship. Schema-congruence theory [5] demonstrates that memory performance improves when information is congruent with an individual's pre-existing schemas [6]. If physical flexibility underlies metaphorical schemas of adaptability, then individuals may recall more effectively when the content of a behavior aligns with their bodily condition. For example, a highly flexible individual may find it easier to remember narratives about compromise and adaptability, whereas a less flexible individual may show stronger recall for stories about rigidity and resistance to change.

Despite the theoretical plausibility of this link, the connection between physical flexibility and memory has not yet been empirically tested. This study addresses this gap by examining whether bodily flexibility interacts with the type of behavior depicted in memory tasks. By combining physical assessments with a cognitive flexibility measure, the Wisconsin Card Sorting Test [7], our study seeks to broaden embodiment research and explore how bodily traits beyond lateral asymmetries may influence cognition.

The research question guiding this study is: Does physical flexibility influence memory for metaphorically aligned behavioral content? H_0 will be: there is no interaction between a participant's physical flexibility and the type of behavioral content on memory performance. Any difference in recall scores between high-flexibility and low-flexibility participants for flexible and rigid-behavior scenarios is due to chance. H_1 will be: there is a statistically significant interaction between physical flexibility and behavioral content on memory performance, consistent with the conceptual metaphor. Specifically, memory performance will be enhanced when the participant's bodily state (high or low flexibility) aligns with the metaphorical meaning of the behavior described (flexible or rigid).

High-flexibility participants will recall more details from flexible-behavior scenarios than low-flexibility participants. Low-flexibility participants will recall more details from rigid-behavior scenarios than high-flexibility participants.

2. Method

2.1. Participants

Sixty adults between the ages of 18 and 40 will be recruited from local universities and online forums. Participants will be screened for major musculoskeletal injuries or neurological conditions that might interfere with flexibility testing or cognitive tasks. Physical flexibility will be assessed through standardized measures such as the sit-and-reach test and goniometer-based assessments of hip and shoulder flexibility. To maximize contrast between groups, only participants in the top 33% (high flexibility) and bottom 33% (low flexibility) of scores will be included in the analysis. Participants in the middle range will be excluded.

2.2. Design

The experiment employs a 2 × 2 mixed design. Flexibility level (high vs. low) serves as a between-subjects factor, while vignette type (flexible vs. rigid behavior) serves as a within-subjects factor. The dependent variable is the number of idea units correctly recalled from each vignette during free recall.

2.3. Materials

Participants will be presented with short written vignettes describing everyday situations. Half of the vignettes will involve flexible behaviors (e.g., adapting to unexpected changes, compromising in social interactions), and the other half will describe rigid behaviors (e.g., adhering strictly to rules, refusing to adapt). Each vignette will contain a fixed number of idea units to standardize recall scoring.

In addition, participants will complete a computerized version of the Wisconsin Card Sorting Test (WCST), which measures cognitive flexibility through rule-switching and categorization. Standard performance indices will be recorded, including perseverative errors, categories achieved, and conceptual level responses. A composite mental flexibility score will be created by z-scoring and averaging across indices.

To control for individual differences, several covariates will be collected. These include working memory span (digit span or Trail Making Test A), physical activity level (measured by the IPAQ-short), self-reported sleep quality for the past week, handedness index, and demographics such as age, sex, and education.

2.4. Procedure

After providing informed consent, participants will undergo a brief warm-up before completing standardized flexibility tests. Next, they will complete the computerized WCST, followed by the vignette reading and recall task. For each vignette, participants will be given a brief period to study the passage, followed by a free recall test in which they write down as many details as possible. Finally, participants will complete covariate measures and demographic questionnaires before being debriefed. The entire session will last approximately 35 to 45 minutes.

3. Expected results

It is expected that a significant interaction effect will emerge between physical flexibility and vignette type (as illustrated in Figure 1). Specifically, participants with high physical flexibility are predicted to recall more idea units from flexible-behavior vignettes, while participants with low physical flexibility are predicted to recall more from rigid-behavior vignettes. No overall main effect of flexibility is anticipated, suggesting that the groups will not differ in general memory ability, but rather in the alignment between bodily state and metaphorical content.

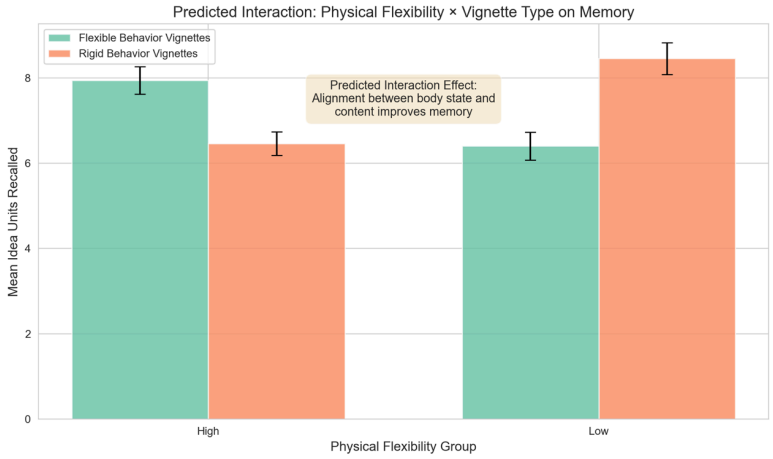

Figure 1. The predicted interaction effect between physical flexibility and vignette type on memory recall performance

Furthermore, WCST performance is expected to correlate with recall of flexible-behavior vignettes, particularly among high-flexibility individuals, reflecting a convergence between physical and cognitive measures of flexibility. Such findings would provide evidence that embodied traits interact with semantic encoding processes in memory.

4. Discussion

This study proposes that physical flexibility may influence memory through metaphorical alignment with behavioral content. If the predictions are supported, the results will extend the Body Specificity Hypothesis by showing that embodiment effects are not limited to lateral asymmetries such as handedness but also encompass broader bodily traits. Importantly, the study will connect embodiment theory with schema-congruence research, suggesting that bodily states can function as schemas that structure memory performance.

The implications of this research are multifaceted. In education, instructors might harness embodied metaphors to enhance learning by aligning instructional strategies with students' embodied experiences. In therapy, interventions that target bodily flexibility—such as stretching or yoga—could potentially influence cognitive adaptability through embodied metaphorical pathways.

Several limitations should be acknowledged. By excluding participants with mid-range flexibility scores, the study may sacrifice generalizability for statistical contrast. The vignette task, while controlled, may lack ecological validity compared to real-life events. Future research could employ longitudinal designs or cross-cultural samples to assess whether embodied metaphors linking flexibility and adaptability are universal or culturally contingent.

Overall, this study represents an initial step toward broadening the embodiment literature, providing evidence that the body's capacity for flexibility may shape not only movement but also memory and cognition.

5. Conclusion

In conclusion, this study proposes a novel investigation into the link between physical flexibility and memory, grounded in the principles of embodied cognition. We hypothesize that individuals' memory performance will be facilitated when the metaphorical content of information (flexible or rigid behaviors) aligns with their own bodily state (high or low physical flexibility). This work seeks

to broaden the scope of the Body Specificity Hypothesis by moving beyond lateral bodily asymmetries to explore a different dimension of bodily experience.

If our hypotheses are supported, the implications would be significant for fields such as education and cognitive therapy, suggesting that leveraging embodied metaphors could enhance learning and adaptability. For future research, longitudinal studies could examine whether improving physical flexibility through training (e.g., yoga) subsequently enhances cognitive flexibility and memory for metaphorically congruent content. Additionally, cross-cultural comparisons would be valuable to determine the universality of these embodiment effects.

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