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Body-Specificity: Do Children with Overweight Respond More Slowly to Action Verbs?

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Abstract. This paper hypothesises that weight as a physical characteristic may influence children's perception of and response to different stimuli. One of the experimental hypotheses is that compared to overweight children, children with a healthy weight are expected to respond faster to both motion-related and non-motion-related verbs. In addition, overweight children would be expected to respond slower to motion-related verbs than non-motion-related verbs, whereas healthy-weight children would not show a significant difference in their responses to the two verb types. In terms of prediction, the Bayesian linear mixed-effects model predicted that healthy-weight children would respond faster overall than overweight children to both verb types. The study involves 48 children aged 8-13, divided into two groups based on BMI: 24 overweight and 24 healthy-weight children. Participants are screened for major health issues, and parents complete a child behavior questionnaire to control for psychological symptoms. Using a lexical decision task on a computer, children identify whether displayed items are words or non-words, pressing keys to respond. The target words include neutral and sports-related terms to measure response speed differences between groups, analyzed using Bayesian linear mixed-effect models.

Keywords: body-specificity hypothesis, overweight, sport

1. Introduction

An early study showed that spatial memory cannot be properly characterised as a simple invariant isomorphic representation of either empirical or research space. Instead, spatial representations are flexible, malleable, and susceptible to a number of factors that affect their access and use [1]. In the Tárrega study, it was noted that there would be no difference in lexical decision time between food-related and non-food-related words in children of healthy weight [2]. However, overweight children

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developed a bias towards food-related stimuli, so they responded faster to food-related words than to non-food-related words [2]. This result suggests that food-related words have a special status (i.e., important stimuli) in overweight children that elicits motivated responses to food-related stimuli. In addition, fMRI experiments showed that food-related words activate the reward system more than non-food-related words [2]. Researchers have also reviewed studies on the body-specificity hypothesis, which suggests that physical traits like handedness, footedness, weight, and blindness shape cognition. While handedness has been widely studied, showing associations between dominant hands and positive thoughts, other traits have been less explored. Footedness impacts how people associate valence with movement, while weight influences children's responses to food-related stimuli, though results in adults are inconsistent. Blindness affects spatial and sensory cognition. The authors call for more experimental research to explore causality beyond correlations [3]. Another research review of neurological and behavioral evidence supports the body-specificity hypothesis, which posits that physical traits like handedness, footedness, and other body parts influence cognition. Their study focuses on how handedness affects action-verb processing, valence associations, and visuospatial attention. They also explore other traits like footedness, showing that motor fluency impacts valence judgments. The authors advocate expanding research to include cultural contexts, motivational factors, and neuro abnormalities, emphasizing the need for broader studies beyond handedness [4].

Based on this, the question we will explore is:

The big theoretical question is whether body-specificity, such as weight difference, affects children's cognitive processing and reaction time to action-related stimuli, particularly through motor cortex involvement in lexical-semantic tasks.

The experimental Question is: do overweight children have slower reaction times to movement-related verbs compared to non-movement-related verbs, and how do their response patterns differ from those of children of healthy weight in lexical decision-making tasks?

2. Hypothesis

1.Weight as a bodily trait can influence children's perceptions and reactions.

2.Experimental Hypothesis: Children with a healthy weight will respond slower than Children with a healthy weight will respond to both sport-related and non-sport-related verbs. Additionally, children with overweight will respond more slowly to sport-related verbs than to non-sport-related verbs, while children with a healthy weight will show no significant difference between the two verb types.

3.Alternative Hypothesis/ Null Hypothesis: There will be no significant difference in response times between children with healthy weight and children with overweight to sport-related and non-sport-related verbs. Both groups will respond similarly across both types of verbs.

3. Method

3.1. Participants

The study will involve 48 children, a sample size similar to that in previous studies [5]. Our age range is 8-13 years—we chose this range because participants are old enough to understand and complete the task while avoiding puberty's effects [2]. There are 24 overweight children (37.5% of them have a BMI greater than 30) and 24 healthy-weight children with BMI percentiles less than 85 [6].

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It is essential that all participants be free of major illnesses and medications that could affect body weight (e.g., diabetes, psychotropic drugs, corticosteroid therapy). Each parent will be asked to complete a child behavior questionnaire in order to control for subclinical psychological symptoms[2]. Age and gender will not significantly differ between the two groups.

3.2. Materials

We will select 90 neutral words（including the sports words we want to test.）from the Affective Norms for English Words (ANEW) database [7]. The neutral words are selected to eliminate the influence of emotion on the speed of lexical decisions. The mean valence for these words is 5, and these words are matched in arousal 4.9 [4.85 for related sports words].

3.3. Procedure

The lexical decision task will be performed individually on a Windows PC running DMDX [8].

Each trial displays a fixation point (+) in the center of the screen for 500 ms. In the following steps, the target word (always presented in lowercase, in black on a white background) is displayed in the center of the computer screen until the participant responds or until 3000 ms have passed. The inter-trial interval is 1.5 seconds. Participants are informed that they need to determine whether the item on the screen is a word or a non-word. If the item is a word, press the M key, and if it is a nonword, press the Z key while answering as accurately as possible.

3.4. Data analysis

We will still use Bayesian linear mixed-effect models of Tárrega, J et al.to compare whether obese children respond more slowly to sports vocabulary than normal children [2].

4. Predictions

According to Bayesian linear mixed-effect models [2], we predict that children with healthy weight will respond faster than children with overweight to both sports verbs and non-sports verbs in general. Specifically, children with healthy weight will show similar response times to both sports verbs and non-sports verbs. In contrast, children with overweight will respond more slowly to sports verbs than they do to non-sports verbs (see Fig. 1).

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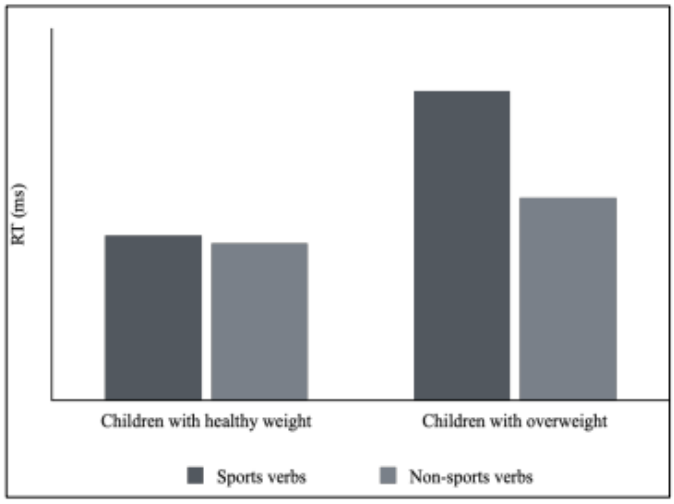

Figure 1: Predictions of the proposed study

The left panel of Fig. 1 presents the response times of children with healthy weight to both sports verbs and non-sports verbs. Children with healthy weight show no significant difference in response times to both kinds of verbs. The right panel of Fig. 1 presents the response time of children with overweight to both sports verbs and non-sports verbs. The response times of children with overweight to sports verbs are slower than to non-sports verbs.

5. Discussions

The body-specificity hypothesis [9] has posted a solid explanation of people's differences in perceiving and interacting with the external world based on their differences in the major hand side. Our proposal focused on another relatively novel field of body-specificity, in which we suggest that children with higher weights show a tendency to react slower when perceiving an action-related world. We propose the underlying causes are that children with high weight might have restrictions to freely reinforce physical movements that are complex or that are across various kinds. Besides, they are restrained from following physically demanding motor orders by applying corresponding movements. These might lead to the lack of ability to fully activate or utilize their premotor cortex to reinforce those movements properly and freely, which might affect the potential development of their premotor cortex in terms of oppression, causing less developed and flexible brain tissues than those children with normal health conditions and who can apply physical movements freely. Previous studies have shown that the meanings of action-verbs are stored and reflected in the motor cortices that are used to apply those actions. We believe that due to the lack of development of motor cortices, their lexico-semantic function could face constraints, causing these children to have less immediate activation of these parts of the brain after perceiving those words.

We want to deduce some potential factors that might cause the precise results of our study to have less adaptability on other subjects, for finally, a conclusion on whether the findings can only apply to children. The first factor is the overall development of brain structure. Adults normally have relatively mature development of brains, which means that the differences that can be brought to brain development in childhood due to the differences in physical ability have the potential to be varied or compensated through the long-term development of the body. This indicates that if the body-specificity effect based on physical differences is strongly related to the different

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developments of the brain, whether this kind of difference will remain in adulthood is still unclear in this study.

The second factor is the difference between how children and adults understand action-verbs. Children normally have the tendency to focus more on the explicit meaning of the words given to them because they are less likely to analyze the other implications of those words due to the extent of educational and social influence. This means that they are more likely to catch the meaning of that action but not the other implicit meanings of specific words. However, adults have the potential to understand some of these words with other implications, not only focusing on physical meaning (e.g., drive). So, for adults, there could be a potential difference in the activated motor cortex area. This effect might not be significant in English but can be misleading in other language, like Chinese. Further experiments can be done focusing on other aspects of body-specificity or widen the range of the research population to expand the knowledge of this hypothesis in terms of its wider range of application on individuals.

6. Conclusion

In summary, this paper hypothesizes that overweight children take longer to respond to motor-related words. This further supports the idea of the "body specificity hypothesis" that different body specificities lead to different cognitive patterns. Should the hypotheses presented in this paper be subjected to empirical testing, it would be possible to gain further insight into whether there is an emotional dimension to the speed of response of obese children to exercise vocabulary and whether this is a consequence of negative emotions resulting from their rejection of exercise. It would be beneficial for future research to examine the prevalence of impacts across age groups. In order to gain a more comprehensive understanding, experiments should be conducted not only among children but also among adolescents and adults.

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