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Représentations externes pour l'apprentissage et la comparaison de la consommation d'énergie

External representations for learning and comparing energy consumption

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ABSTRACT

In this thesis is first considered how energy is taught and learned about in school, focusing on the discrepancies between a scientific definition of energy and a societal definition of energy, and discussing units of energy and the confusion they induce. Perspectives for education and energy management are provided. Then, focus is placed on the representations of energy provided in home energy management systems, seeking to propose an original classification based on educational strategies. The major obstacles met by designers reveal how energy management tools can be adapted to human cognition. Next, human numerical and magnitude processing abilities are discussed in depth, taking the viewpoint of grounded cognition and building a framework through which the impact of external representations of energy on learning and comparing can be established, understood, and predicted. This leads to two empirical studies.

The first study tests the effect of external representation (symbolic or spatial) on recall and comparisons from memory. Accuracy and response time at comparisons are used as dependent variables. Results indicate analog processing of magnitude in both conditions, and show that external representation affects performance at both recall and comparison, with symbolic external representation increasing recall and comparison accuracy, and spatial external representation increasing comparison speed. The second study tests the effects of spatiality, groundedness, and physicality in external representations, also on recall and comparisons from memory, using the same dependent variables. Results indicate analog processing in all conditions. Spatiality decreases recall accuracy but increases comparison speed. Groundedness and physicality show no effect.

Results are consistent with grounded cognition's mental simulations hypothesis (Barsalou, 1999, 2008; Wilson, 2002) as well as Dehaene's (1997) view on numerical cognition, in which number sense is based on a continuous accumulator that does not directly process discrete numbers. Theoretical implications and practical applications are discussed.

RÉSUMÉ

Dans cette thèse est d'abord considéré comment l'énergie est enseignée et apprise à l'école, montrant les divergences entre définition scientifique et sociétale de l'énergie, et considérant les unités d'énergie et la confusion qu'elles engendrent. Des perspectives pour l'éducation et la gestion de l'énergie sont présentées. Ensuite, l'attention est portée sur les représentations de l'énergie proposées par les systèmes domestiques de gestion, et une classification originale basée sur des stratégiques didactiques est proposée. Les obstacles majeurs rencontrés par les designers révèlent comment les outils de gestion de l'énergie peuvent être adaptés à la cognition humaine. Enfin, les capacités humaines de traitement des grandeurs numériques sont examinées en profondeur du point de vue de la cognition incarnée. Un cadre est construit au travers duquel l'impact des représentations externes de l'énergie sur l'apprentissage et la comparaison peut être établi, compris, et prédit. Ceci mène à deux études empiriques.

La première étude teste l'effet de la représentation externe (symbolique ou spatiale) sur le rappel et la comparaison de mémoire. Précision et temps de réponse sont les variables dépendantes dans la comparaison. Les résultats indiquent un traitement analogique dans les deux conditions. La représentation externe symbolique accroît la précision dans le rappel et la comparaison, et la représentation externe spatiale accroît la vitesse de comparaison. La seconde étude teste l'effet de la spatialité, de l'ancrage, et de la physicalité dans les représentations externes, également sur le rappel et les comparaisons de mémoire, utilisant les mêmes variables dépendantes. Les résultats indiquent un traitement analogique dans toutes les conditions. La spatialité décroît la précision dans le rappel mais accroît la vitesse de comparaison. Ancrage et physicalité n'ont pas d'effet.

Les résultats corroborent l'hypothèse de la cognition ancrée sur les simulations mentales (Barsalou, 1999, 2008; Wilson, 2002) ainsi que la perspective de Dehaene (1997) sur la cognition numérique, dans laquelle le sens du nombre est basé sur un accumulateur analogique et non discret. Implications théoriques et applications pratiques sont discutées.

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