

A comparison of different levels of interactions when using the isolated-element strategy

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Background (1/2)

Isolated interacting elements effect :

= learning elements are presented in isolation without indicating the manner in which they interact before presenting the full interacting material (e.g. Sweller, 2010)

– is superior to presenting the full interacting material twice

(Pollock, Chandler & Sweller, 2002; Ayres, 2006)

– has been compared or interpreted as

- pre-training effect (Mayer, Mathias & Wetzell, 2002; Clarke, Ayres & Sweller, 2005)
- simple-to-complex sequencing (van Merriënboer, Kester & Paas, 2006)
- molar-modular effects (Gerjets, Scheiter & Catrambone, 2006)
- the use of subgoals (Catrambone, 1998)

Background (2/2)

Studies referenced above share one important feature :

- it's more efficient to acquire knowledge about components before learning the whole than trying to learn the whole directly

But

- our analysis suggest that the promising idea to break down the complexity by isolation of the interacting element is not always implemented in the same manner :
 - > sometimes components are presented in isolation form with no interaction between them
 - > sometimes components are presented in isolation but with some interactions still present

Previous experiments

Bellec & Tricot, 2010, 2011

- > The two experiments shows no difference between “elements before whole” and “whole before elements” presentations, even if:
 - Exp.1: small learning effect
 - Exp.2: big learning effect

- > Order seems to have a no role with our material

- > It seems possible to hypothesize that isolated interacting elements effect is actually linked to isolation and not to the presentation order

Aim

The aim of this study was to compare 3 modes of presentation of a system from its element :

- > isolated elements with no interactions before a presentation of the whole interacting system
- > partially interacting elements before a presentation of the whole interacting system
- > a direct presentation of the whole interacting system

And tested if the isolated interacting elements effect can be considered as

- > a general effect of simplification of the whole interacting system

or

- > if it's more closely linked to the isolation of interacting elements rather than simplification

Method (1/2)

Participants : 43 students of a technical college from Poitiers (France) randomly assigned to one version of the material

Learning support : a computer based material with a 2-stages design about the effectiveness of hybrid engines as a solution to the reduction of greenhouse gas emissions (9 components or variables in interaction)

Versions of presentation :

- > Non interacting strategy : Stage 1 with strong isolation of the components or variables and stage 2 presentation of the whole interacting system
- > Partially interacting system : Stage 1 with presentation of components or variables in interaction between them and stage 2 presentation of the whole interacting system
- > Total interacting strategy : Stage 1 with a presentation of the whole interacting system and stage 2, the same presentation

Method (2/2)

Pre- test: 29 questions to evaluate the students prior knowledge one week before the passations

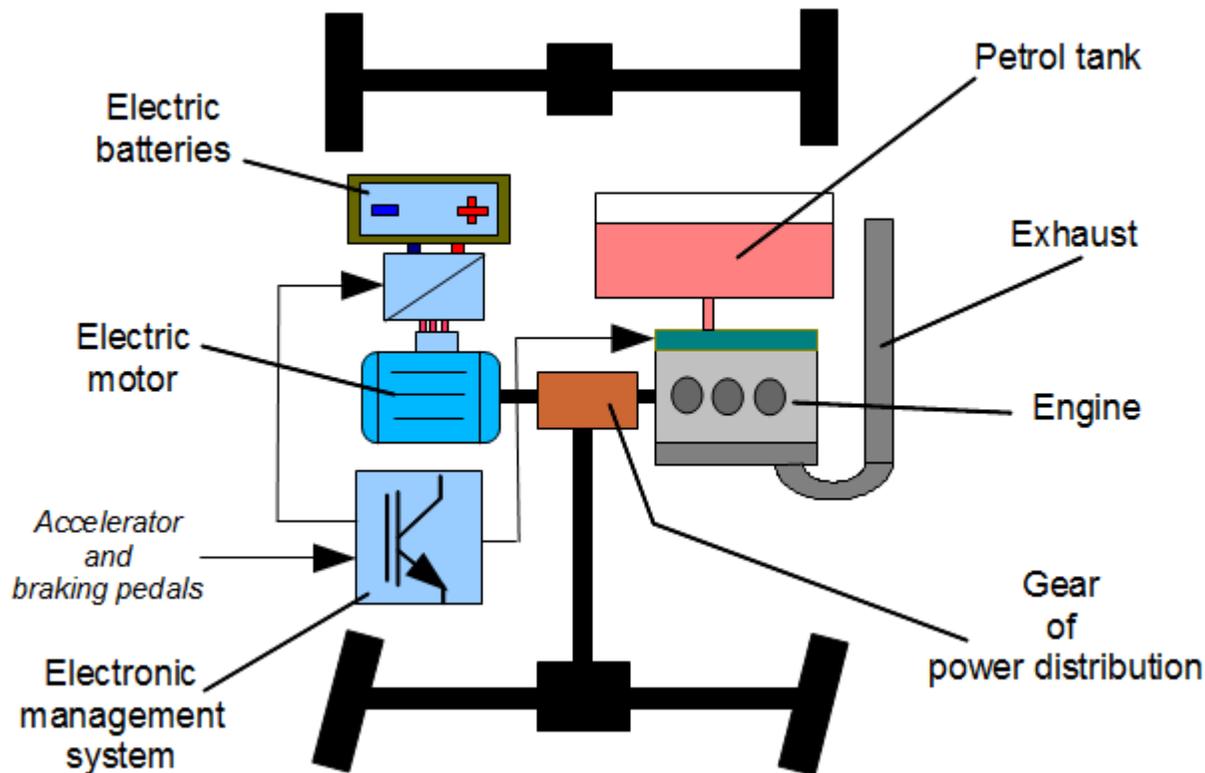
- > 20 questions for a future recall
- > 9 questions for a future transfert

Post-test : same as the pre-test

Mesure of mental effort : 9 points Lickert scale after each learning phases

thermal-electric hybrid motor : a complex system

Organization



Four driving situations :

- start-up
- braking
- driving at constant speed
- strong acceleration

Two sources of energy available (or not available) :

- petrol in the tank
- electric energy in the battery

Variables : strenght, power, kinetic energy, torque, consumption, production of carbon by gas, transformation of energy electrical <> mechanical, electric energy storage)

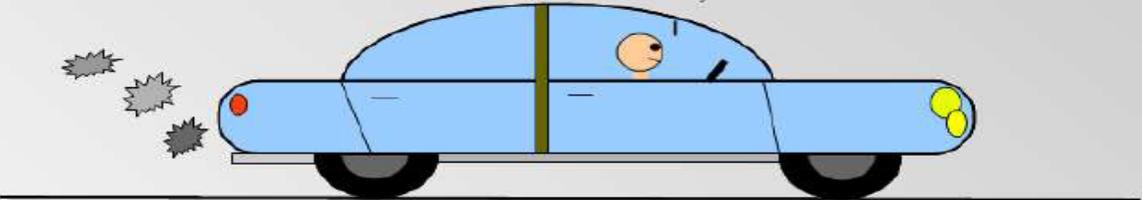
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thermal-electric hybrid motor : levels of presentation of kinetic energy

The non interacting strategy

La motorisation hybride des véhicules automobiles : une réponse à la réduction des gaz à effet de serre ?

Lorsqu'une voiture est en mouvement, elle possède une énergie cinétique E_c .
L'énergie cinétique E_c s'exprime en J.



← →

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thermal-electric hybrid motor : levels of presentation of kinetic energy

The partially interacting strategy

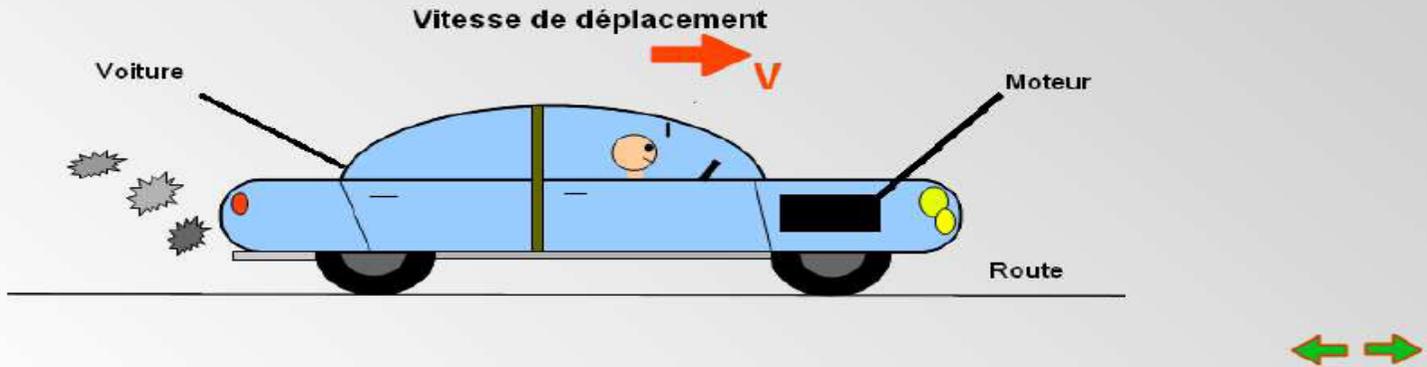
La motorisation hybride des véhicules automobiles : une réponse à la réduction des gaz à effet de serre ?

Lorsqu'une voiture de masse m se déplace à une vitesse V , elle possède une énergie cinétique E_c telle que :

$$E_c = 1/2 \cdot m \cdot V^2$$

E_c est exprimé en J (Joule), On rappelle que 1 J = 1 Ws (Watt . seconde)
 m est exprimé en Kg (Kilogramme)
 V est exprimé en m/s (mètre par seconde)

Lorsque la voiture est en phase de ralentissement elle restitue cette énergie. Si cette énergie peut être récupérée et stockée dans des batteries, des économies de carburant peuvent être réalisées. Ceci suppose que la chaîne de transmission située entre la motorisation et les roues soit réversible. Cette énergie ne peut pas être récupérée par la voie thermique car le moteur thermique ne fabrique pas de carburant quand son axe de sortie est entraîné par un dispositif extérieur !



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Results

	Recall questions		Transfert questions		Mental effort	
	Pre Test	Post Test	Pre Test	Post Test	Phase 1	Phase 2
Non interacting	11.6	13.4	3.1	3.3	4.00	6.44
Partially interacting	12.0	13.4	2.0	4.7	4.50	4.44
Total interacting	10.4	13.6	1.9	4.1	4.50	4.57

- > No significant difference between the 3 conditions for recall questions
- > For transfer questions, a significant difference between the non interacting condition and total interacting condition (total interacting was superior)
- > No significant difference between the 3 conditions for the mental effort invested in phase 1 but a significant difference between the non interacting group and the other 2 groups

Discussion

- > Unexpectedly, compared with previous research (see Pollock et al., 2002), isolating elements in an initial stage about a complex system didn't offer a better learning :
 - no difference in recall
 - inferior on transfer problems

- > The non-interacting strategy induces a greater mental effort during the presentation of the second part (total interaction)

- > Previous research has featured less complex material than:

**a more exposure of the various interactions may be needed
to learn a very complex material ?**