

The management of intrinsic vs extraneous cognitive load in second language listening and comprehension task

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The hypothesis of cognitive load management

- Cognitive load is managed by the humans:
 - different strategies are implemented by different participants and have different consequences on performances
- A strategy is a way to perform a task

(Tricot, Sweller, Amadieu, Chanquoy & Mariné, 2008)

A example of CL management: Air traffic controllers

- If the number of aircrafts is low (between 1 and 3)
 - the controllers use sophisticated strategies, taking into account many criteria (security, rapidity of the flow of the stream, fuel consumption, passenger comfort, workload of the crew, and so on)
- If the number of aircrafts is intermediate (between 4 and 8)
 - the controllers use less sophisticated strategies, less criteria are considered (the security, possibly the speed of flow...)
- If the number of aircrafts is important (more than 8)
 - the controllers use rudimentary strategies but very effective, not taking more than a single criterion: security

(Sperandio, 1971)

Cognitive load management

- In solving problems or at work, with children or with adults, the same double phenomenon is observed:
 - (a) different strategies implemented to achieve the same task are more or less costly cognitively, the cost is based on the quantity information to be processed to perform the task,
 - (b) to perform the task, individuals can choose, in a more or less deliberate way, less costly strategies, i.e. reducing the number of information they process without eliminating the most relevant information and without diminishing their probability of succeed.

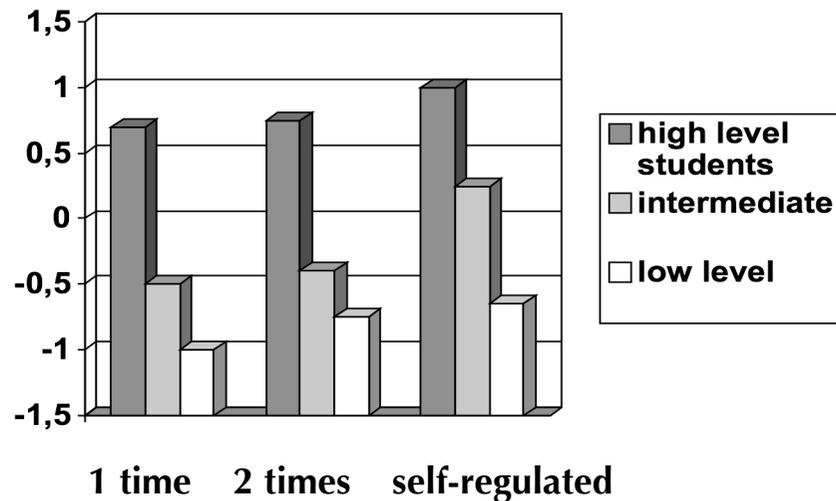
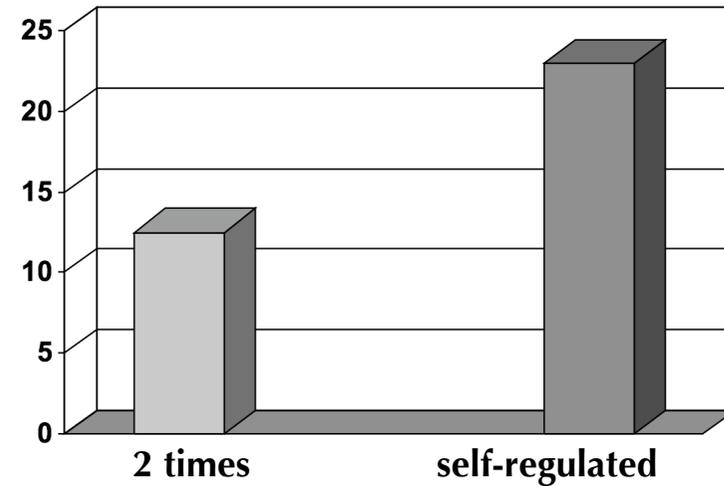
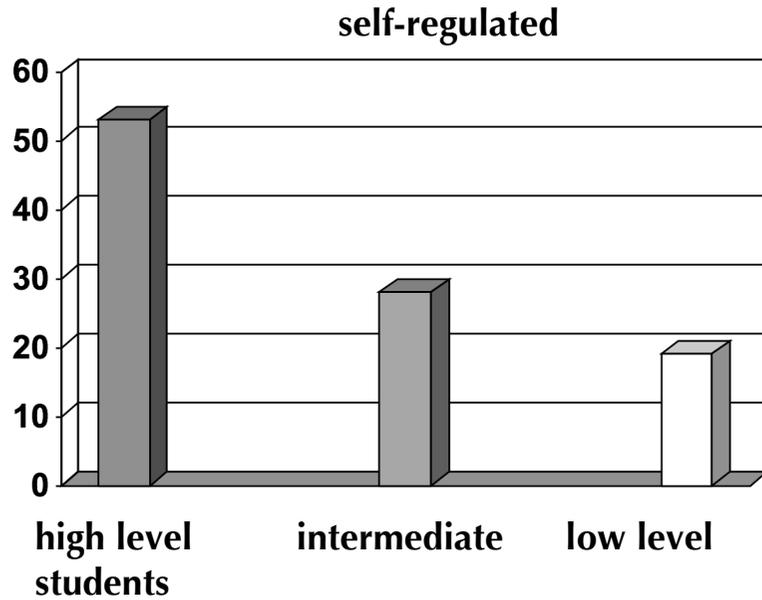
(Bastien, 1987; Bastien, Pélissier & Tête, 1990; Beilock & DeCaro, 2007; Cary & Carlson, 1999; Levin et al., 2007)

A new task to study CL management

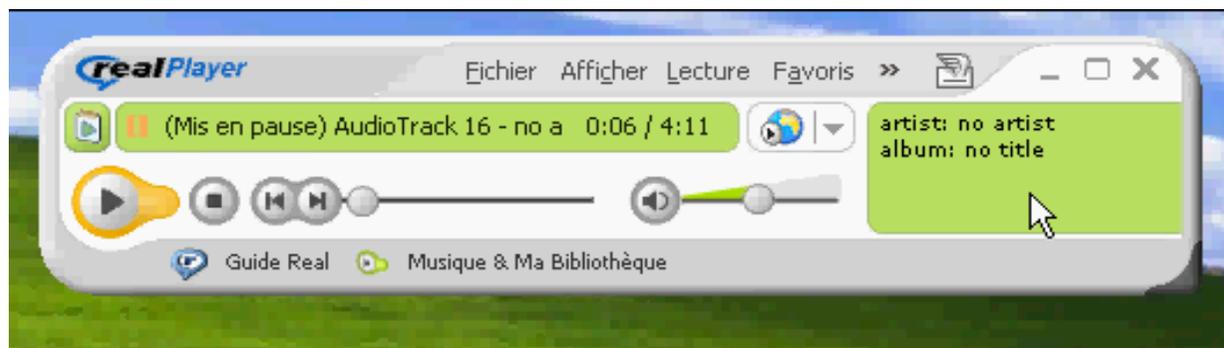
- The analysis of the use of MP3-players (the stop, pause, rewind and fast forward movements) provides information about the learners' self-controlled listening strategies and comprehension in second language learning

(Roussel, Rieussec, Nespoulous & Tricot, 2007)

Previous results: students listen and recall second language discourses

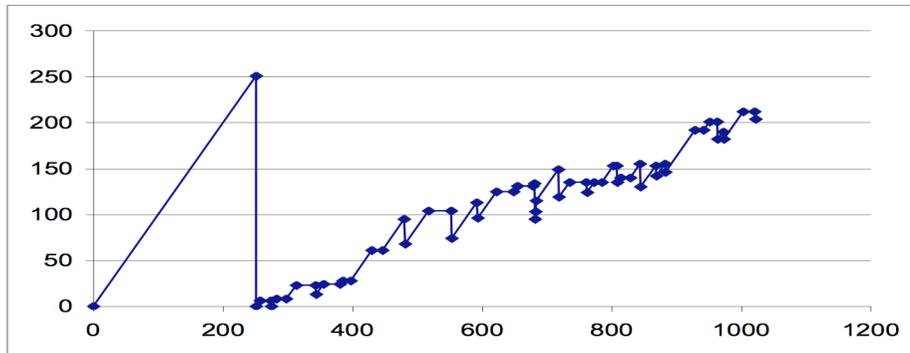


Analysis of the listening behaviour

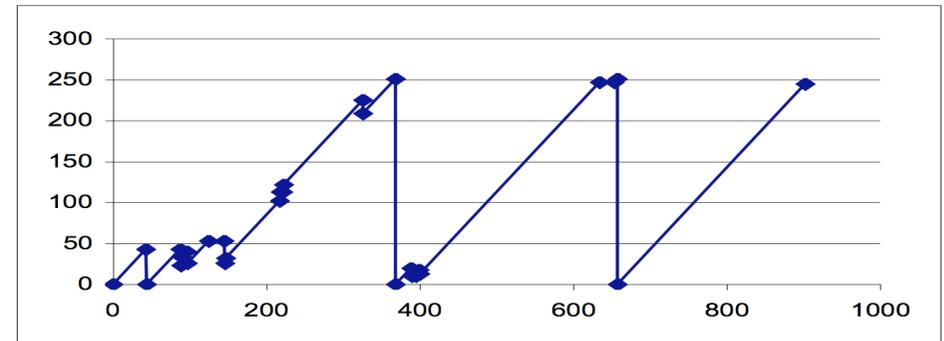


- Event 1: the participant listen a 251 seconds discourse from the beginning to the end
 $E1 = \{0 ; 251 ; 251\}$
- Event 2: the participant go back to the beginning and listen 6 seconds
 $E2 = \{0 ; 6 ; 6\}$
- Event 3: the participant stop during 17 seconds
 $E3 = \{6 ; 6 ; 17\}$
- Event 4: the participant go back to the beginning and stop during 1 second
 $E4 = \{6 ; 0 ; 1\}$

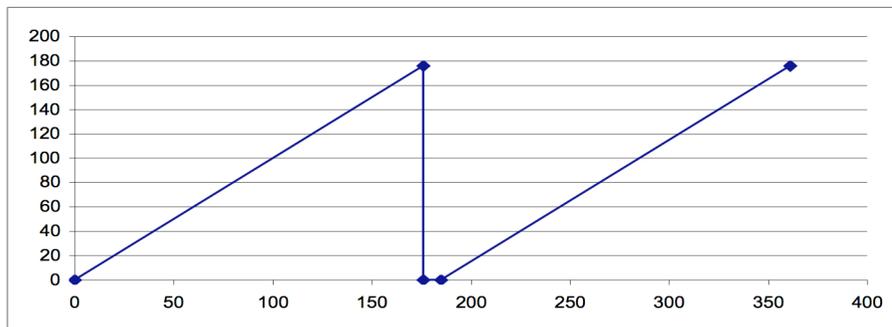
4 types of self-regulated listening strategies



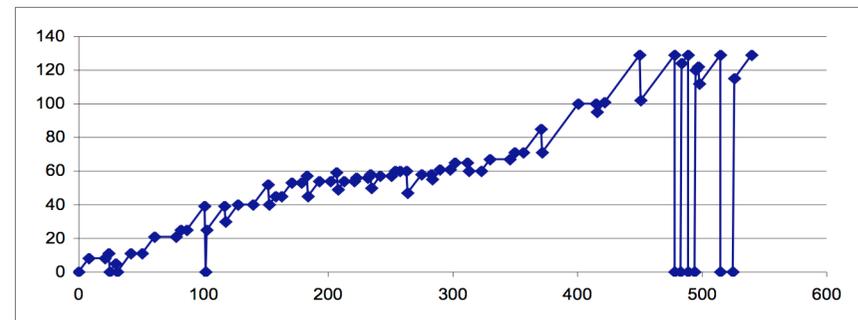
Type 1 : (m=33%)



Type 2 : (m=27%)



Type 3 : (m=25%)



Type 4 : (m=18%)

Method

- In an oral discourse comprehension task, cognitive load was introduced by a specific linguistic difficulty: 6 compound words in German, were placed in a short discourse (100 seconds).

The 6 words

- Der Unternehmensberater (The Business Advisor)
 - Das Wirtschaftsleben (The Economic Life)
 - Die Betriebsleiterin (The Company Director)
 - zahlungsunfähig (bankrupt)
 - Das Beruhigungsmittel (a relaxant)
 - der Wohnzimmer boden (The living room floor)
-
- Unknown, but it is possible to infer their meaning (after time and efforts)

Independent variable: Different Cognitive loads

- Extraneous cognitive load condition
 - compounds are in a non salient-position in incoming discourse, *i.e.* difficult words are not useful to comprehend the discourse
- Intrinsic cognitive load condition
 - the same compounds are in a salient position in another speech sample, *i.e.* it is necessary to understand the difficult words in order to comprehend the discourse

- *Der berühmte **Unternehmensberater** saß im Flugzeug. Er las einen Artikel in einer Zeitschrift, in der er manchmal Artikel schrieb. Die Zeitung hiess « **das Wirtschaftsleben** ». Aber das war ihm völlig egal nach dem, was letzte Woche passiert war. Er hatte seit zwei Jahren eine Liebesaffäre mit einer **Betriebsleiterin** und hatte so viel Geld für diese Geliebte ausgegeben, dass er jetzt deswegen **zahlungsunfähig** war. Er hatte versucht, seine Ehefrau nach Geld zu fragen. Aber sie war so aggressiv und nervös geworden, dass er ihr schließlich eine Tablette, ein starkes **Beruhigungsmittel** in das Essen gemischt hatte, ohne dass sie es merkte. Aber wie hatte er vergessen können, dass seine Ehefrau gerade darauf eine tödliche Allergie bekommt. Die Frau fiel um. Da lag sie nun plötzlich tot auf dem **Wohnzimmerboden**. Er hatte Angst gehabt, schnell seine Sachen gepackt, und das erste Flugzeug genommen. Um sich abzulenken, griff er wieder zu seiner Zeitschrift und las. Lesen würde ihn auf andere Gedanken bringen...*
- *Ein **Unternehmensberater** saß an seinem Schreibtisch. Er war in Gedanken verloren. Er hatte gerade erfahren, dass er jetzt **zahlungsunfähig** war. Er ging zu einer **Betriebsleiterin**, für die er schon gearbeitet hatte, und fragte sie um Hilfe. Sie sagte ihm, dass sie ihm helfen könnte. Sie wollte dafür aber, dass er eine Lösung, fände, ihr Kapital an der Börse zu verdoppeln. Sie würde dann mit ihm ihren Gewinn teilen. Durch seine berufliche Erfahrung kannte er nämlich das **Wirtschaftsleben** sehr gut. Es war seine letzte Chance und er beschloss über diesen Vorschlag nachzudenken. Er ging nach Hause und nahm seinen Kopf in die Hände, nur so konnte er überlegen. Aber er konnte sich nicht konzentrieren. Der Druck war so stark und er war so gestresst, dass er beschloss ein **Beruhigungsmittel** zu nehmen, um besser überlegen zu können. Aber er nahm zu viel davon und plötzlich wurde ihm schwarz vor den Augen und er fiel auf den **Wohnzimmerboden**. Er wollte zum Telefon greifen, um Hilfe zu holen, aber das Telefon stand in der Küche. So starb er einsam an einem Herzinfarkt.*

- **Extraneous cognitive load: The compounds are not relevant to build the situation model**

The famous **Business Advisor** was sat in the plane. He was reading an article in a newspaper, in which he also wrote articles. The newspaper was wall **The Economic Life**. But this did not bother him at all after what had happened the pervious week. He had been having an affair for two years with a **Company Director** and he had spent so much money on this lover that he was now **bankrupt**. He had tried to ask his wife for money, but she became so angry and aggressive that he finally had to mix a **relaxant** into her meal. How could he have forgotten that she had a fatal allergy to relaxants though? His wife collapsed. She was there, dead on the **living room floor**. He was afraid, so quickly packed his bags and took the first plane. To distract himself he read the newspaper. Reading would change his thoughts...

- **Intrinsic cognitive load: The compounds are relevant to build the situation model**

A **Business Advisor** was sat at his desk. He was lost in thought. He had just found out that he was now **bankrupt**. He went to see a **Company Director**, for whom he had worked for already and asked for her help. He said to himself that she could help him. But in exchange, she wanted him to find a solution to double her own capital on the stock market. She would share the profits with him. Thanks to his professional experience he knew the **economic life** inside out. It was his last chance and he decided to think about the offer. He went home with his head in his hands; it was all he could do to think about it. He went home, but he could not concentrate. The stress was so high and he was so stressed that he decided to take a **relaxant** to think better. But he took too much and suddenly he saw black before his eyes and fell on **the floor in the dining room**. He wanted to get to the telephone to call for help but the telephone was in the kitchen. He died of a heart attack.

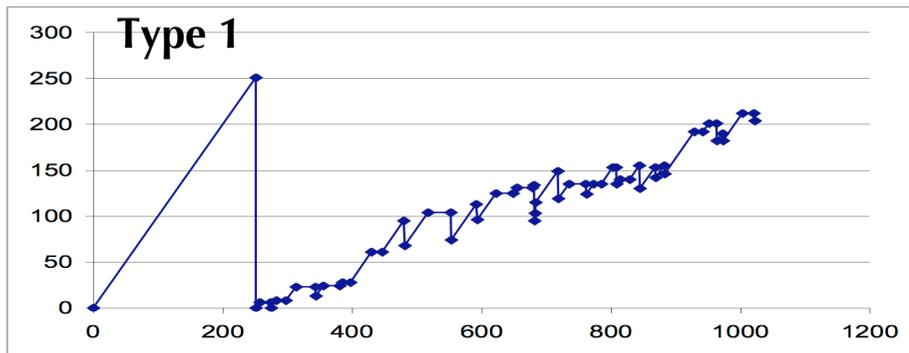
Measures

- Participants
 - 40 students (38 in fact), 10th grade (learning German since 5 years)
- Dependant variables
 - Recall (in French)
 - Overall recall (propositional analysis)
 - Situation model recall
 - Recognition (in German)
 - Compounds recognition
 - Sentences recognition
 - Inference questions (in German)

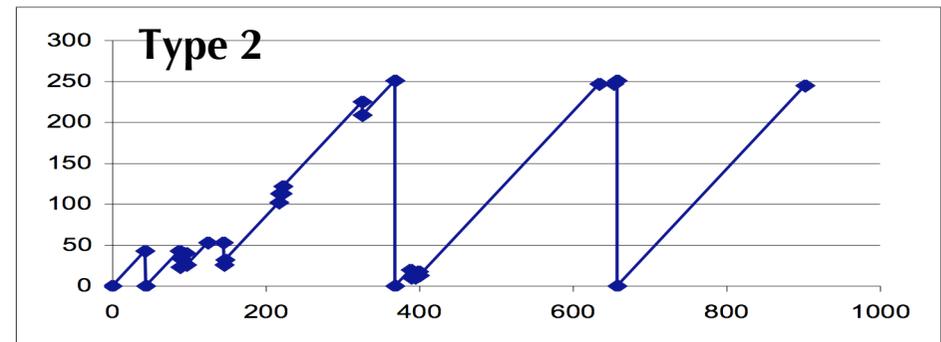
Hypothesis

- Discourse 1: The compounds are not relevant to build the situation model
 - The participants will use strategies of type 1 and 3 (they will not stop, or after a first whole listening)
- Discourse 2: The compounds are relevant to build the situation model
 - The participants will use strategies of type 2 and 4 (they will stop, particularly on compounds)

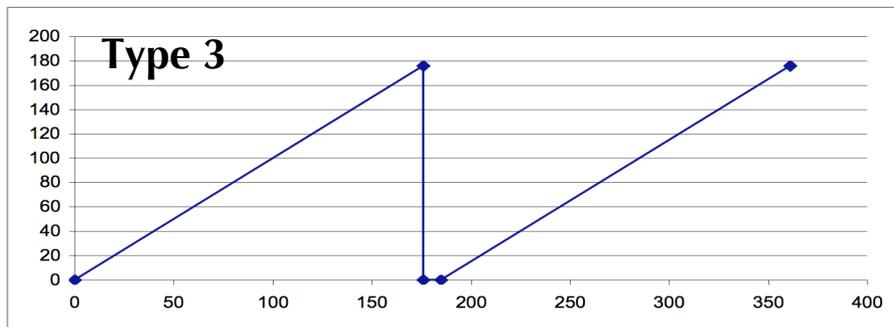
Hypothesis



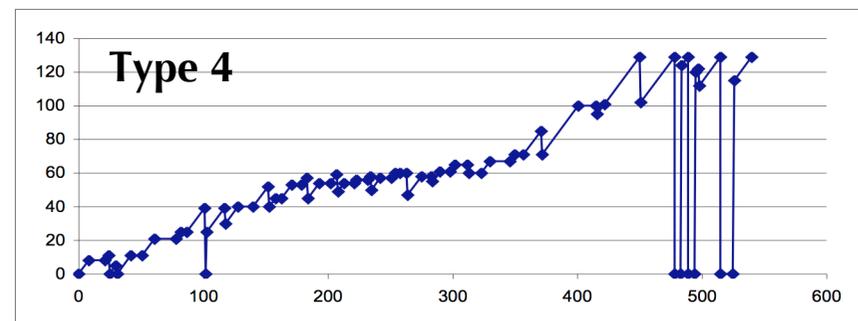
Compounds not relevant: many participants
Compounds relevant: no participant



Compounds not relevant: no participant
Compounds relevant: many participants

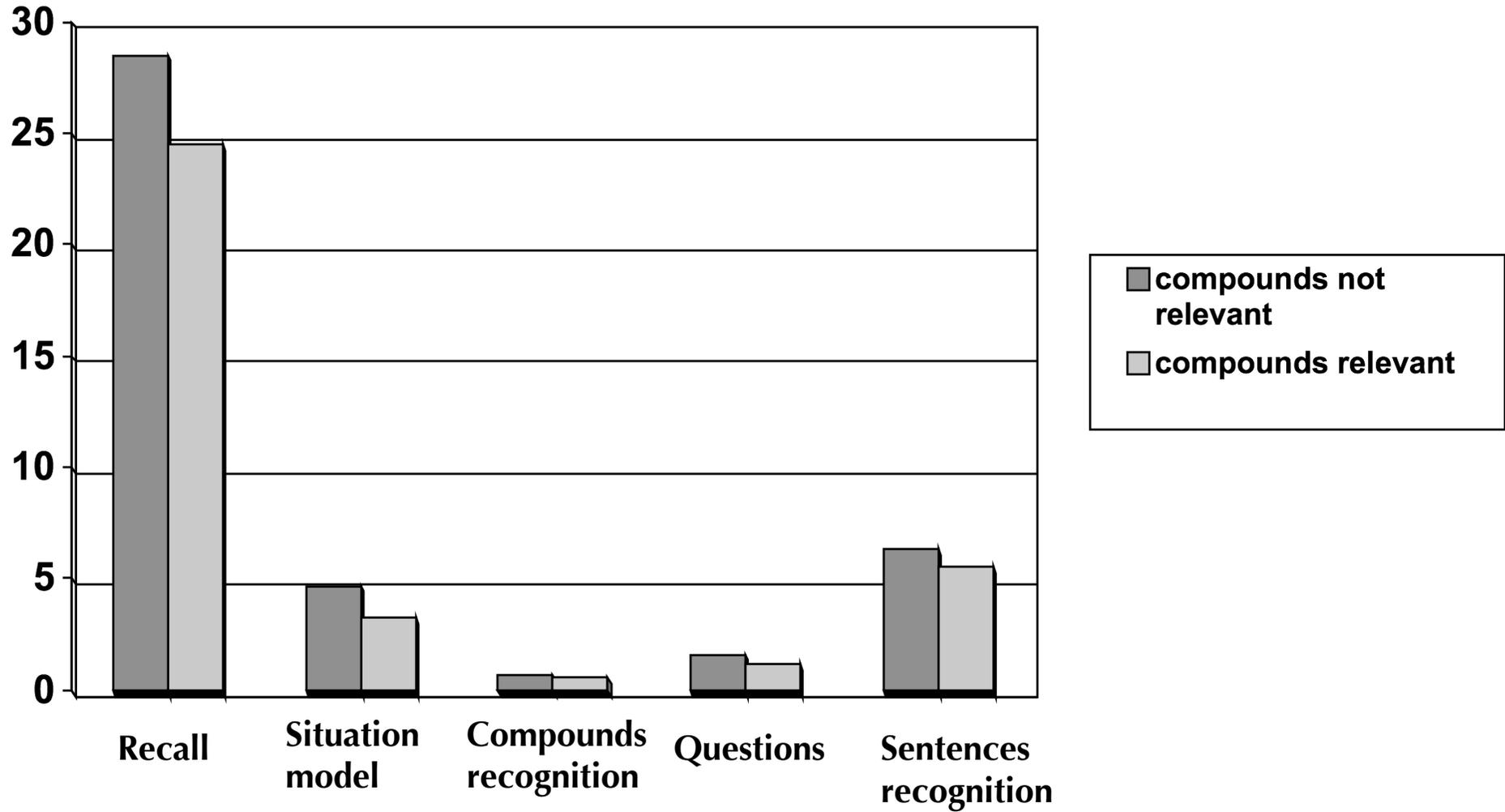


Compounds not relevant: many participants
Compounds relevant: no participant

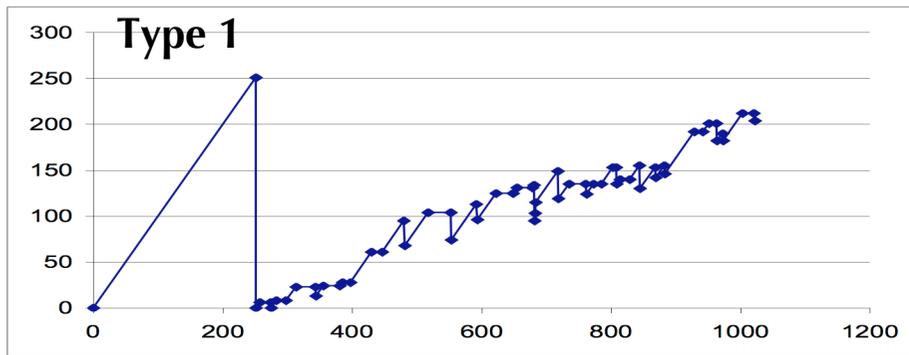


Compounds not relevant: no participant
Compounds relevant: many participant

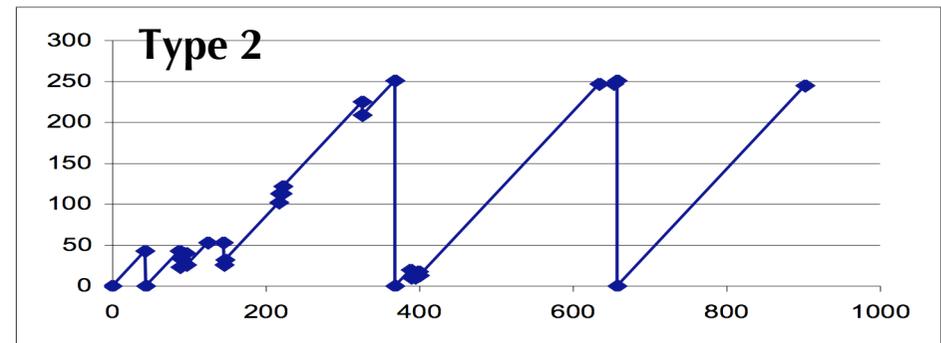
Results



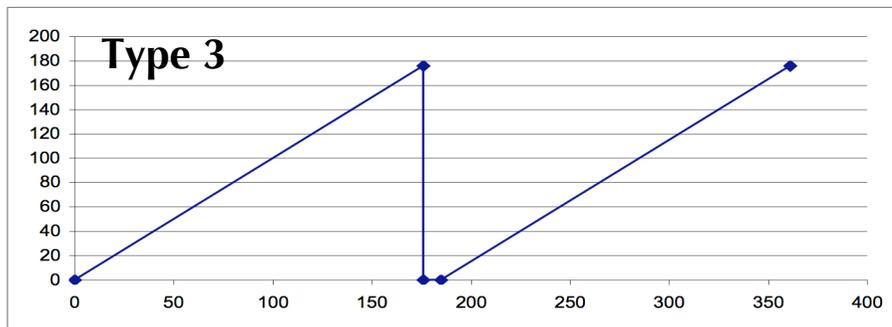
There is no effect of CL conditions on the type of strategy



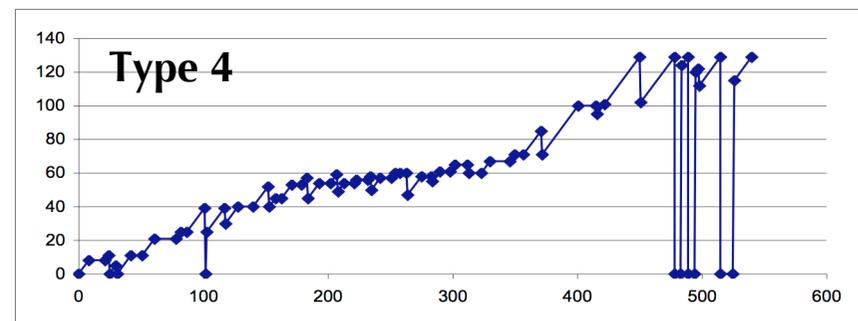
Compounds not relevant: 9 participants
Compounds relevant: 10 participants



Compounds not relevant: 1 participant
Compounds relevant: 1 participant



Compounds not relevant: 7 participants
Compounds relevant: 8 participants



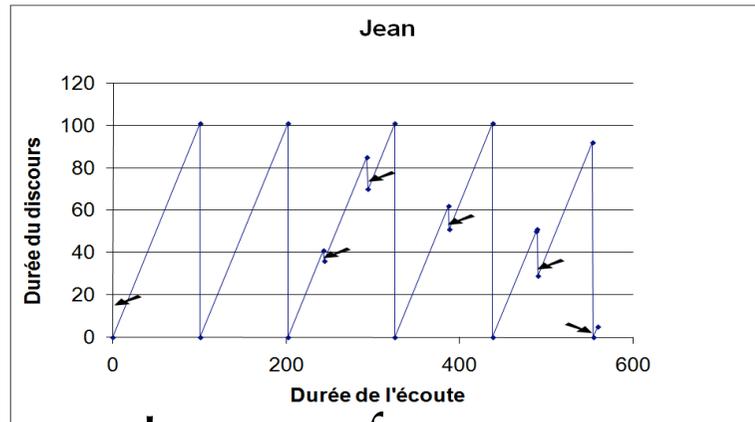
Compounds not relevant: 1 participant
Compounds relevant: 1 participant

Links between strategies and performances

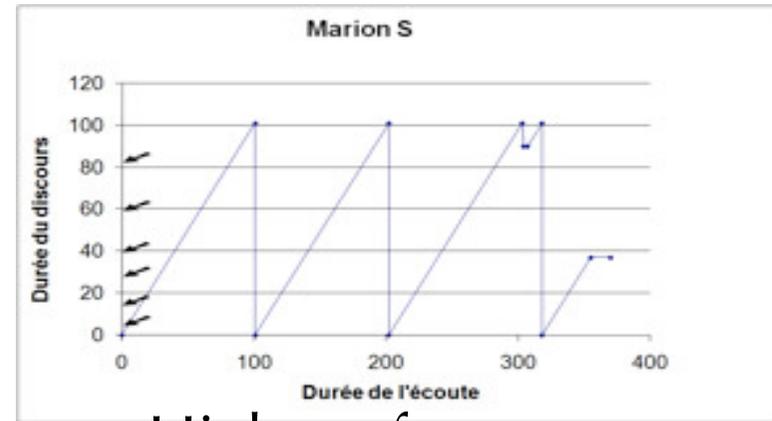
- Discourse 1 (compounds are not relevant)
 - The number of events is negatively correlated with overall recall ($r = -0,36$)
 - The number of events is negatively correlated with situation model ($r = -0,21$)
- Discourse 2 (compounds are relevant)
 - The number of events is positively correlated with overall recall ($r = 0,28$)
 - The number of event is not correlated with situation model ($r = 0,06$)

Examples of listening strategies

Extraneous cognitive load condition: compounds are not relevant

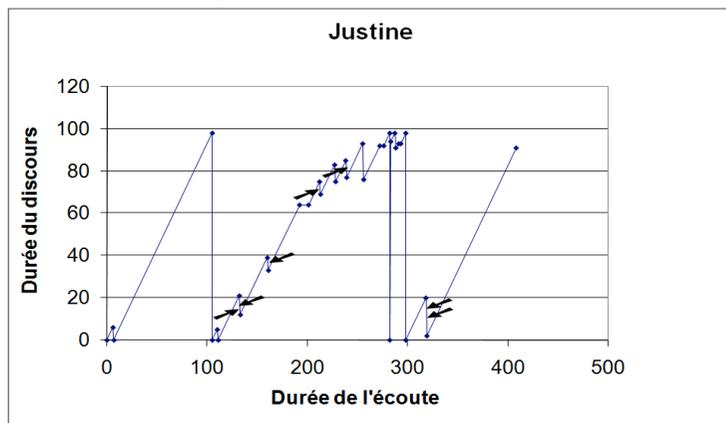


Low performance

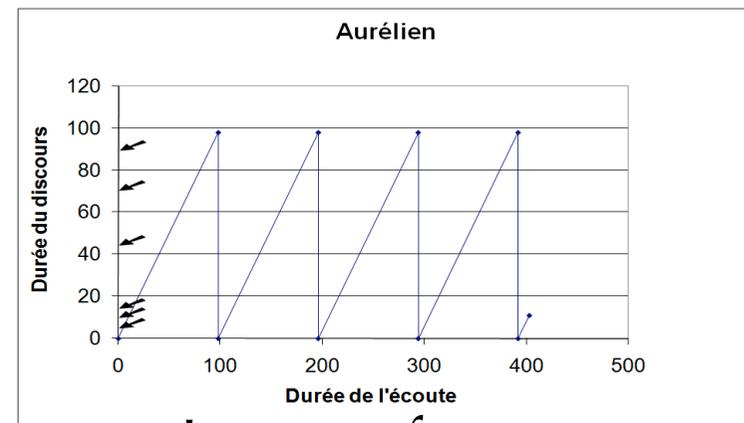


High performance

Intrinsic cognitive load condition: compounds are relevant



High performance



Low performance

Conclusion

- Different kinds of CL management are used
- We still don't understand why some participant choose one strategy or another one
- We are not sure that our way to distinguish intrinsic / extraneous cognitive load (in discourse comprehension) is correct