

Semantic Priming with Polysemic and Monosemic Words in Younger and Older Adults: Does Aging Slow Selection in Semantic Processing?

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Semantic priming of polysemic words, when used on a lexical decision task (LDT), measures two components in the semantic retrieval process : Activation and Selection/Inhibition. The Semantic Priming effect between a condition where the dominant (BANK : place where you keep your MONEY) or the subordinated (BANK : side of a river) meaning is used for the semantic priming demonstrate the difference between conditions. With the dominant meaning, RTs are shorter, potentially reflecting solely the automatic spreading of semantic activation.

With the subordinated meaning, RTs are longer, possibly indicating an additional phase of selection/inhibition. The results on these tasks has shown divergent results: Balota et al. (1999) found equivalent SPE for both conditions in young and older participants while Simpson and Burgess (1985) and Copland et al. (2007) found differential SPE (dominant > subordinated) in young adults.

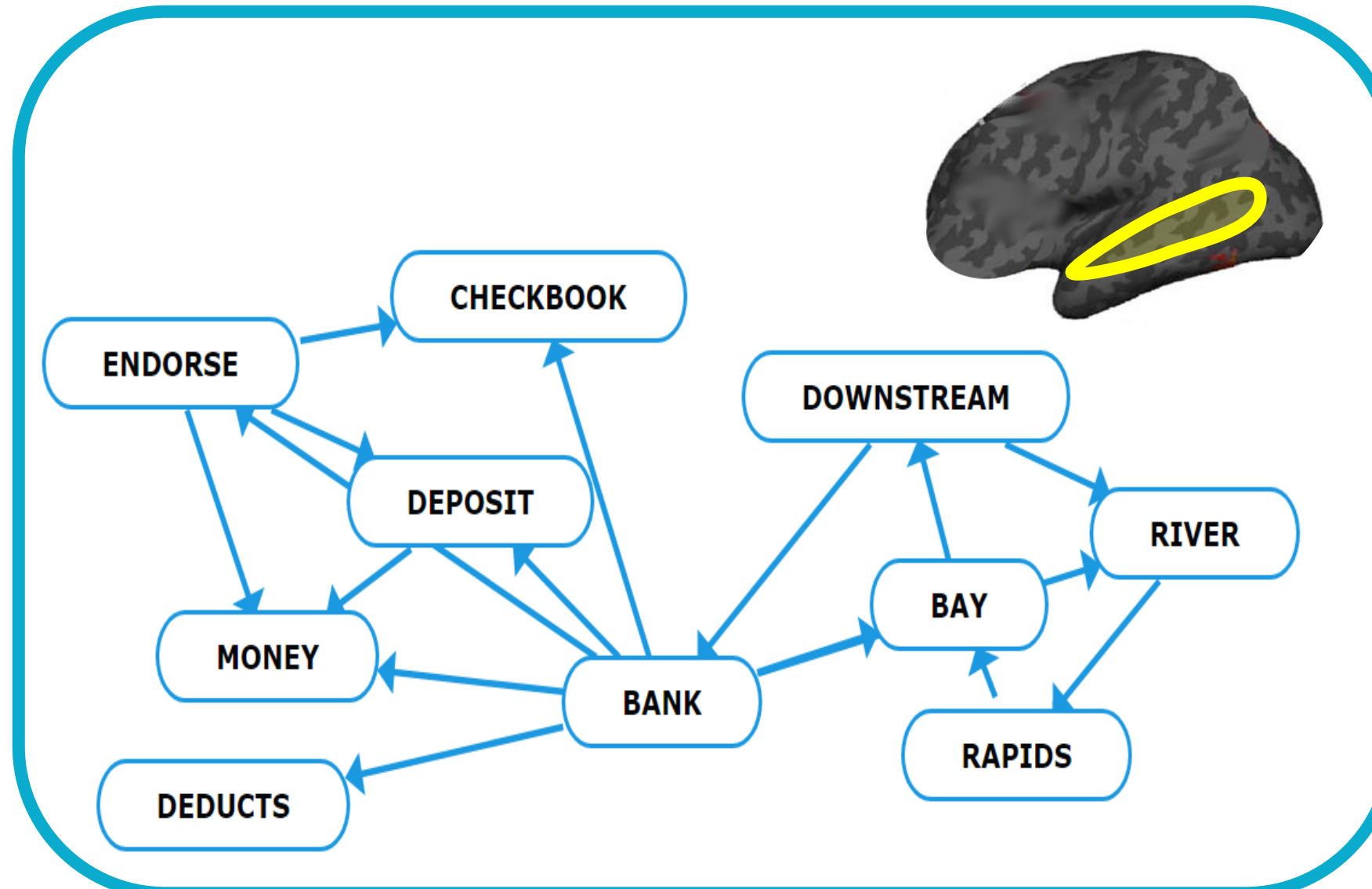
Since the selection process is considered inhibitory, we expected an effect of ageing on the selection process, consistent with the decline in executive functions with aging (Daniels et al., 2006).

Management of lexico-semantic ambiguity as when polysemic words are used, implies a sequence of cognitive processing.

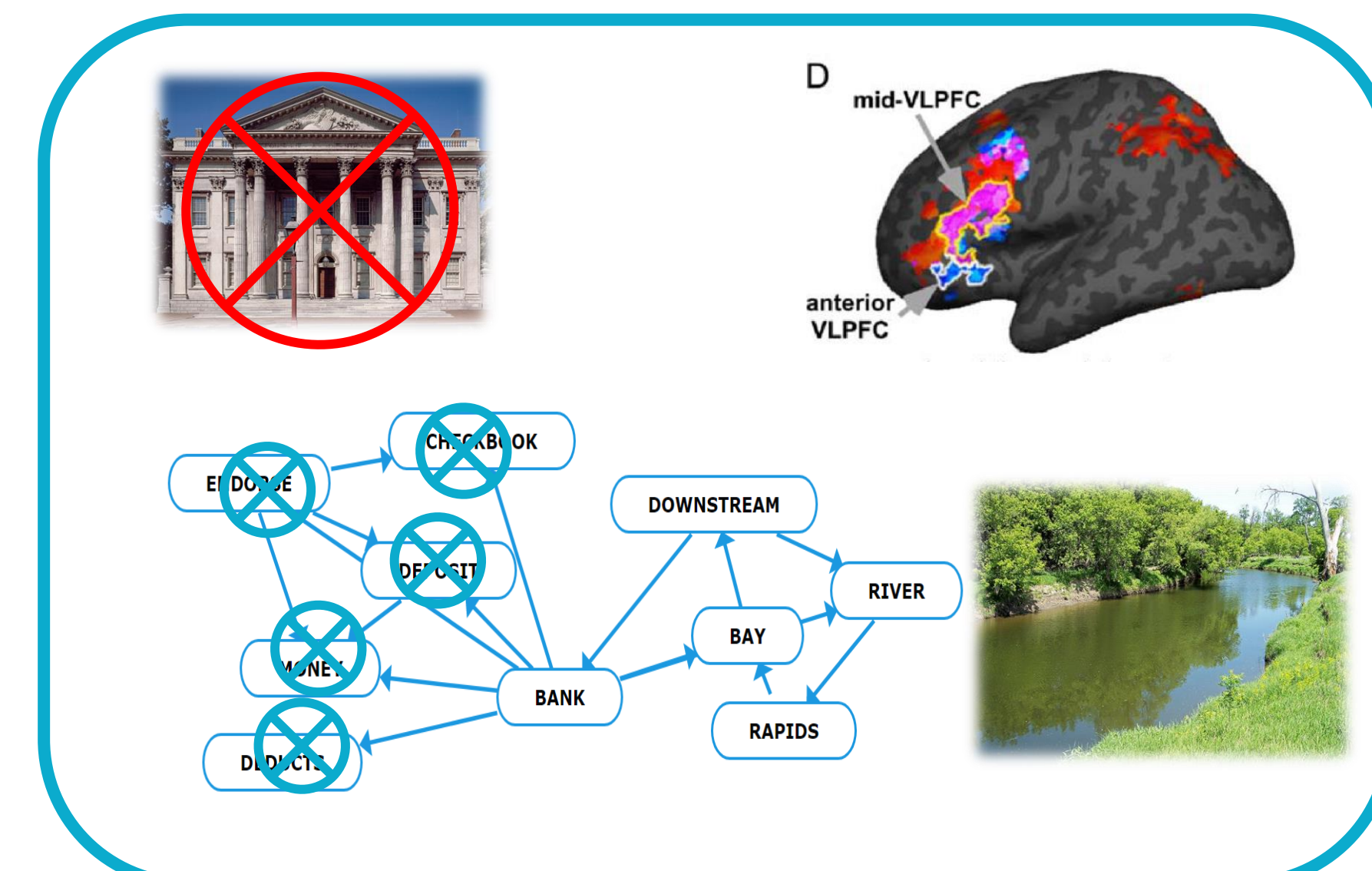
- I forgot my watch on the bank !
 - You mean « In » the bank ?
 - No, « On » the bank of the river !



1 AUTOMATIC SPREADING OF SEMANTIC ACTIVATION
 (Collins et Loftus, 1975), decreased activation on the left middle temporal gyrus observed < 300 ms in (Copland et al., 2003; Holderbaum et al., 2019; Liu et al., 2010; Sachs et al., 2008).



2 SELECTION / INHIBITION (controlled processes)
 Range from 350 to 1000 ms entered the expectancy-based priming theory (Becker, 1980) and correspond to an increased activation of middle temporal gyrus, but also of the middle frontal gyrus (Copland et al., 2007; Holderbaum et al., 2019; Sachs et al., 2011; Wible et al., 2006)



METHOD : LEXICAL DECISION TASK WITH PRIMING*

In this task design to measure **activation of the semantic representation system** and **activation/selection**, participants face a screen where sequences of prime/blank/target are presented and have to judge for every target if it is a word or not. Four contbalanced versions of the task were created with 4 conditions of interest (blue lines of the Table 1).

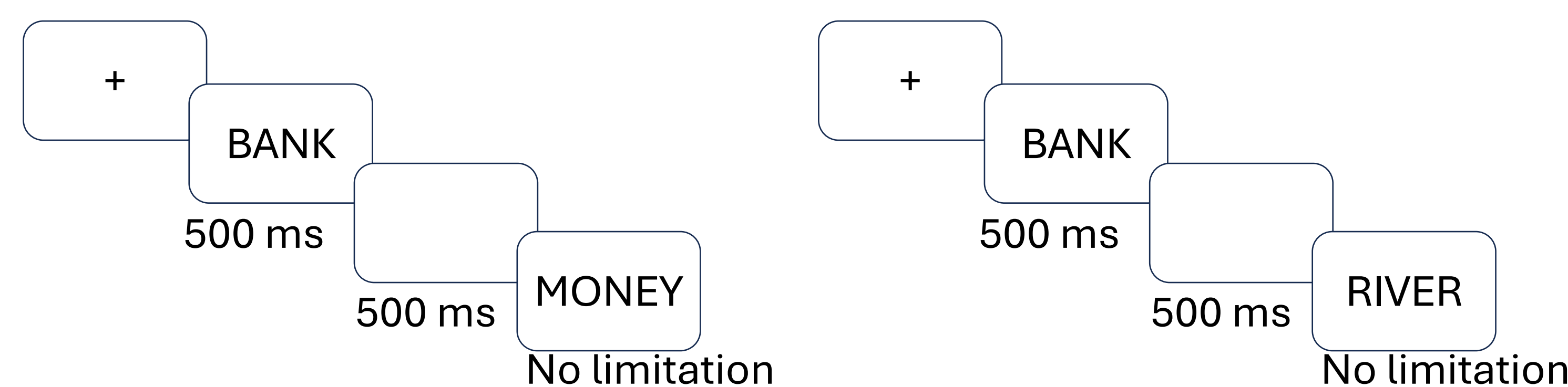
Table 1. Metrics of pairs in the lexical decision task: mean (standard deviation)

Prime – target relationship	N (task)	N (corpus)	Length	Book frequency	LSA (0 / 1)
Polysemic/Dominant e.g. Bank/money (PD)	8	32	6,09 (1,67)	42,74 (36,98)	0,33 (0,20)
Polysemic/ Subordinated e.g. Bank/river (PS)	8	32	6,06 (1,81)	34,19 (38,43)	0,14 (0,08)
Monosmic Word – semantic associate e.g. Desk/screen (SA)	16	64	6,09 (1,87)	39,52 (39,82)	0,26 (0,14)
Word - non related word e.g. River/money (NR)	32	32	6,45 (1,91)	34,66 (33,56)	-
Fill-in unrelated pairs	20	20			
Word – Non-word	84	84			
TOTAL	168	264			

Note. There were no significant differences of metrics between conditions, except for LSA (: strength of lexico-semantic association)
 *inspired by Copland et al. (2007)

	level	older group	younger group	p
N		110	74	
Gender : N (%)	M	46 (41.8)	32 (43.2)	0.968
	W	64 (58.2)	42 (56.8)	
Hand. : N (%)	Left	12 (10.9)	15 (20.3)	0.122
	Right	98 (89.1)	59 (79.7)	
Mean (St. Dev.)				
Age		66.90 (4.47)	26.64 (5.87)	<0.001
Education		13.17 (2.11)	14.16 (1.19)	<0.001

Two groups (older and younger) answered the LDT with unmasked priming (SOA: 1000 ms), 32 polysemic words were followed by a target word semantically related to either their dominant (PD) or subordinated (PS) meaning, while 64 monosemic words were followed by a semantic associate (M). The task was counterbalanced in 4 versions in which were also present non-related pairs of words, and pairs in which the target was a non-word. Each version included 265 items and a unique representation of every word. Primes and targets were counterbalanced across related and unrelated conditions.



RESULTS AND DISCUSSION

SA	BOAT NAVIGATION	younger : 742 ± 174 ms older : 869 ± 188 ms
NR	TOWEL MAP	younger : 767 ± 181 ms older : 888 ± 192 ms
PD	BANK MONEY	younger : 733 ± 173 ms older : 863 ± 191 ms
PS	BANK RIVER	younger : 761 ± 185 ms older : 882 ± 204 ms

Analysis F2 : SPE of polysemic dominant versus subordinated

$$SPE (mRT) = \frac{(mRT_{subordinated} - mRT_{dominant})}{(mRT_{subordinated} + mRT_{dominant})} \times 100$$

SPE younger group // SPE older group : (Z = -0.4, p = .7)

Mixed linear regression (MLR), including possible random variability of participant and word, was performed on the reaction time (RT) of correct answers (97.4%) and showed a main effect of the PD condition ($t=3.25, p=.002$) and of the group ($t=-5.48, p<.0001$). MLR performed separately on the dataset for each group showed a significant ($p<.0001$) facilitation effect of the PD and PS conditions in both groups. However, when we compared the SPE between them; PD facilitation was significantly higher than PS for both groups, while M facilitation was significantly higher than PS only for the older participants. An F2 analysis was conducted to compare the facilitation effect when associating the dominant meaning versus the subordinate meaning of each polysemous word in both groups. A comparison of the distribution of these effects showed no difference between the younger and older groups.

Our experiment showed that all participants experienced facilitation in PD condition and that this facilitation was stronger than when a monosemic word was used as the prime. The difference cannot be attributed to the strength of semantic association, which was consistent in both conditions. Instead, it supports the idea that polysemous words are semantically richer than monosemic words (Klein & Murphy, 2001). Since the selection process is considered inhibitory, we anticipated differences between the groups, consistent with the decline in executive functions with aging (Daniels et al., 2006). This might indicate that the selection phase occurring in this processing before 1000 ms remains within the uncontrolled processes and is therefore less affected by the effects of cognitive aging.

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