# Experiment 2

#### March 13, 2015

## 1 Outline of experiment

Participants viewed scenes while hearing sentences. Of interest were the speed of anticipatory eye movements towards the second object named in the sentence. Sentences came in pairs of primes and targets. Two features of the prime sentences were manipulated:

- whether prime was unmarked or marked
- whether prime was in English or Italian

Additionally, participants were either attriters or learners.

The target was always an Italian OVS sentence. Therefore for the prime to be SVO or Italian would consitute a switch (either of construction or of language).

As we were interested in the effects of these manipulations on anticipation, we analysed their effects on time (as a two-order polynomial, i.e. a linear and quadratic component). Furthermore, we tested the relationship between executive function (quantified as conflict, an ANT measure) and anticipation by including this as a predictor in our models. Analyses were conducted across a 1600ms window, which is approximately the time from the offset of the first noun phrase to the onset of the second.

#### 1.1 Caveats

When interpreting the findings there are a couple of factors that should be kept in mind:

- Targets are always in Italian
  - therefore attriters switch into their L1
  - $-\,$  while learners switch into their L2  $\,$
- English and Italian primes differ in more than just language

- for Italian primes, either SVO or OVS
- for English primes, either active or passive

As a result, if switching costs are asymmetric then we might expect an interaction between group and language switch, while an interaction between language and construction switch could represent a difference between SVO vs. OVS and active vs. passive.

## 2 Summary of results

Individual analyses were conducted by-subjects and by-items. As executive function varies between subjects, and each subject saw all items, it would not make sense to include it in the by items analysis. Therefore we report only on the results of the by- subjects analyses. The full results of each analysis are presented near the end of this report.

Both construction and language switches were found to interact with time (quadratic component). Crucially for the prediction that executive function would correlate with switching, a five-way interaction was found between time (linear component), construction, language, group, and conflict. These effects were further investigated by analysing data from the attriters and the learners individually.

#### 2.1 Attriters

Post-hoc testing suggests that when a construction switch took place, attriters experienced an effect of language switching which was modulated by their executive function. For low-EF attriters, a language switch was costly, with anticipatory looks to the object that would subsequently be mentioned occuring later than when a language switch had not occured. However, for high-EF attriters, a language switch was beneficial, with anticipatory looks occuring earlier.

When a construction switch took place, attriters were found to be slower to look towards the object when a language switch had also occured. This did not, however, interact with their EF.

#### 2.2 Learners

When a language switch had not taken place, a relationship was found between construction switching and executive function. High-EF learners experienced a switching benefit, which would represent anti-priming, while low-EF learners were unaffected by the switch. When a language switch had taken place, learners did not experience an effect of construction switches.

Other than this interaction with construction switching, no effects of language switching were found for learners.

## 3 Followup experiment

A subsequent experiment was conducted with Italian monolinguals. As with the first experiment, the construction of the prime was manipulated; however, the language of the prime was not manipulated.<sup>1</sup>

No effect of construction switch was found on anticipatory looks to the target. This null result would therefore resemble the findings for low-EF learners. However, note that the construction switch effect found with attriters did not interact with their executive function, so it may not be reasonable to assume that the monolinguals had poorer executive function than the attriters.

## 4 Models

##		Estimate	Std.	Error	t value	
##	(Intercept)	-0.7545		0.046	-16.497	
##	t1	12.6654		2.058	6.153	
##	t2	-2.3730		1.755	-1.352	
##	lang	0.0020		0.027	0.076	
##	cons	0.0276		0.027	1.032	
##	group	-0.1490		0.046	-3.259	
##	conflict	-0.0766		0.047	-1.643	
##	t1:lang	-1.1496		2.058	-0.558	
##	t2:lang	3.9690		1.755	2.261	
##	t1:cons	-0.5868		2.058	-0.285	
##	t2:cons	-4.5221		1.755	-2.576	
##	lang:cons	0.0056		0.027	0.209	
##	t1:group	-3.0271		2.058	-1.471	
##	t2:group	-0.6820		1.755	-0.389	
##	lang:group	0.0245		0.027	0.916	
##	cons:group	0.0083		0.027	0.310	
##	t1:conflict	-0.2296		2.099	-0.109	
##	t2:conflict	1.1716		1.791	0.654	
##	lang:conflict	0.0140		0.027	0.514	
##	cons:conflict	0.0206		0.027	0.756	
##	group:conflict	0.0822		0.047	1.765	
##	t1:lang:cons	2.1734		2.058	1.056	
##	t2:lang:cons	2.2627		1.755	1.289	
##	t1:lang:group	2.0585		2.058	1.000	
##	t2:lang:group	-1.8064		1.755	-1.029	
##	t1:cons:group	-2.1758		2.058	-1.057	
##	t2:cons:group	0.0520		1.755	0.030	

#### 4.1 By-subjects analysis

<sup>1</sup>Unlike the first experiment, SVO sentences were also used as targets. Data from these targets have not been analysed.

lang:cons:group	-0.0076	0.027	-0.283	
t1:lang:conflict	1.2027	2.099	0.573	
t2:lang:conflict	0.1979	1.791	0.111	
t1:cons:conflict	-1.6023	2.099	-0.764	
t2:cons:conflict	-0.2427	1.791	-0.136	
lang:cons:conflict	-0.0258	0.027	-0.945	
t1:group:conflict	2.6357	2.099	1.256	
t2:group:conflict	-0.9685	1.791	-0.541	
lang:group:conflict	-0.0429	0.027	-1.572	
cons:group:conflict	-0.0434	0.027	-1.591	
t1:lang:cons:group	1.9939	2.058	0.969	
t2:lang:cons:group	1.1767	1.755	0.670	
t1:lang:cons:conflict	-2.5296	2.099	-1.205	
t2:lang:cons:conflict	3.1261	1.791	1.746	
t1:lang:group:conflict	-2.2667	2.099	-1.080	
t2:lang:group:conflict	2.4134	1.791	1.348	
t1:cons:group:conflict	-1.5661	2.099	-0.746	
t2:cons:group:conflict	-1.1513	1.791	-0.643	
lang:cons:group:conflict	0.0133	0.027	0.487	
<pre>t1:lang:cons:group:conflict</pre>	4.2229	2.099	2.012	
t2:lang:cons:group:conflict	2.1043	1.791	1.175	
	<pre>lang:cons:group t1:lang:conflict t2:lang:conflict t1:cons:conflict t2:cons:conflict lang:cons:conflict t1:group:conflict t2:group:conflict lang:group:conflict t1:lang:cons:group t2:lang:cons:group t1:lang:cons:conflict t1:lang:group:conflict t1:lang:group:conflict t1:lang:group:conflict t1:lang:group:conflict t1:lang:group:conflict t1:cons:group:conflict t1:cons:group:conflict t1:lang:cons:group:conflict t1:lang:cons:group:conflict t1:lang:cons:group:conflict t1:lang:cons:group:conflict t1:lang:cons:group:conflict</pre>	lang:cons:group -0.0076   t1:lang:conflict 1.2027   t2:lang:conflict 0.1979   t1:cons:conflict -1.6023   t2:cons:conflict -0.2427   lang:cons:conflict -0.0258   t1:group:conflict 2.6357   t2:group:conflict -0.0429   cons:group:conflict -0.0429   cons:group:conflict -0.0434   t1:lang:cons:group 1.9939   t2:lang:cons:group 1.1767   t1:lang:cons:conflict -2.5296   t2:lang:group:conflict -2.2667   t2:lang:group:conflict -1.5661   t1:cons:group:conflict -1.5661   t2:cons:group:conflict -1.5661   t2:cons:group:conflict -1.561   t2:lang:cons:group:conflict -1.1513   lang:cons:group:conflict 0.0133   t1:lang:cons:group:conflict 4.2229   t2:lang:cons:group:conflict 2.1043	lang:cons:group-0.00760.027t1:lang:conflict1.20272.099t2:lang:conflict0.19791.791t1:cons:conflict-1.60232.099t2:cons:conflict-0.24271.791lang:cons:conflict-0.02580.027t1:group:conflict2.63572.099t2:group:conflict-0.96851.791lang:group:conflict-0.04290.027cons:group:conflict-0.04340.027t1:lang:cons:group1.99392.058t2:lang:cons:group1.17671.755t1:lang:cons:conflict-2.52962.099t2:lang:group:conflict-2.26672.099t2:lang:group:conflict-1.56612.099t2:lang:group:conflict-1.56612.099t2:cons:group:conflict-1.56612.099t2:cons:group:conflict-1.15131.791lang:cons:group:conflict-1.01330.027t1:lang:cons:group:conflict2.10431.791	lang:cons:group-0.00760.027-0.283t1:lang:conflict1.20272.0990.573t2:lang:conflict0.19791.7910.111t1:cons:conflict-1.60232.099-0.764t2:cons:conflict-0.24271.791-0.136lang:cons:conflict-0.02580.027-0.945t1:group:conflict2.63572.0991.256t2:group:conflict-0.96851.791-0.541lang:group:conflict-0.04290.027-1.572cons:group:conflict-0.04340.027-1.591t1:lang:cons:group1.99392.0580.969t2:lang:cons:group1.17671.7550.670t1:lang:group:conflict-2.52962.099-1.205t2:lang:group:conflict-2.26672.099-1.080t2:lang:group:conflict-1.56612.099-0.746t1:cons:group:conflict-1.56612.099-0.746t2:cons:group:conflict-1.56612.099-0.746t2:cons:group:conflict-1.15131.791-0.643lang:cons:group:conflict-1.15131.791-0.643lang:cons:group:conflict2.10431.7911.175

# 4.2 By-items analysis

##		Estimate	Std.	Error	t value	
##	(Intercept)	-0.7942		0.063	-12.635	
##	t1	11.6748		3.537	3.300	
##	t2	-2.2276		2.512	-0.887	
##	lang	0.0033		0.025	0.133	
##	cons	0.0358		0.025	1.424	
##	group	-0.1115		0.025	-4.430	
##	t1:lang	0.9642		2.185	0.441	
##	t2:lang	3.2980		1.960	1.682	
##	t1:cons	0.0687		2.185	0.031	
##	t2:cons	-5.2601		1.960	-2.683	
##	lang:cons	-0.0057		0.025	-0.225	
##	t1:group	-3.2413		2.185	-1.484	
##	t2:group	-0.9905		1.960	-0.505	
##	lang:group	0.0222		0.025	0.881	
##	cons:group	-0.0037		0.025	-0.147	
##	t1:lang:cons	0.8972		2.185	0.411	
##	t2:lang:cons	1.3626		1.960	0.695	
##	t1:lang:group	2.1119		2.185	0.967	
##	t2:lang:group	-2.3758		1.960	-1.212	
##	t1:cons:group	-2.1778		2.185	-0.997	
##	t2:cons:group	0.5254		1.960	0.268	
##	lang:cons:group	-0.0021		0.025	-0.084	

##	t1:lang:cons:group	1.8594	2.185	0.851
##	t2:lang:cons:group	0.6213	1.960	0.317

## 5 Figures

In the remainder of this report, graphs of model estimates (taken from the full by subjects model) are presented with 95% confidence intervals. Estimates are broken down by group and condition, and also according to high and low EF scores (taken to be 2 SD above or below the mean, respectively).