CAHIER DE LABORATOIRE

François Pignon

July 13, 2014

TITLE: experiment #03, Positive or negative valence for the mental representation of abstract concepts as a function of handedness
Acronym: left-rightconcepts

BACKGROUND: Previous work (e.g., Casasanto, 2009) suggests that mappings from spatial location to emotional valence differed between right- and left-handed participants. Right-handers tended to associate rightward space with positive words (e.g., goodness, intelligence, attractiveness and honesty) and leftward space with negative words (e.g., wickedness, stupidity, disgust, dishonesty) but left-handers showed the opposite pattern, associating rightward space with negative words and leftward with positive words. Thus, this seems to suggest that individuals implicitly associate words denominating good things more strongly with their dominant side: the side on which they can act more fluently with their dominant hands. In other words, people form implicit and strong links between the valence of words in their language and their dominant hand through experience.

PURPOSE: This hypothesis of how implicit spatial-valence associations emerge makes important predictions for people whose experience with both language and hand use vary. Specifically, who work with their hands could be more sensitive to this kind of embodied cognition than those who do not work with their hand. Similarly, monolinguals have more experience with their native language than bilinguals with either of their languages, and so, monolinguals should have stronger associations than bilinguals. Moreover, previous studies lacked a baseline where differences between the groups should not differ (words with neutral valence). It is therefore unclear from the previous work what is the role of language and manual experience is in the spatial valence effect, and whether the effect is mostly positive or negative with respect to a neutral baseline. Finally, previous work has relied on a rather explicit task where names of objects were located on the left or right side of a screen. Here, we want to use a much more implicit task using reaction times on a word-nonword decision task and capitalizing on the spatial congruency effect as documented in ().

PREDICTIONS: We will test the mappings from spatial location to emotional valence between right- and left-handed participants in French, and we predict that the degree of valence assigned to some lexical items will be modulated by the handedness of participants (as in previous work), their native language (monolinguals show stronger modulation than bilinguals), and if they use their hands to work (in which case, the effect is stronger).

MATERIALS AND METHODS: To address this question, we will test two groups of 12-15 participants with the following criteria:

- Half of the participants should be right-handed and half left handed
- Half of the participants should be male and half female
- Half of the participants should be native speaker of French and half bilinguals (with any other language).
- Half of the right- and the left- handed participants should have a job in which they have to use their hands (e.g., a painter, cooker, etc).

We will use the lexical decision task (e.g., Forster & David, 1984) to measure the reaction time spent by participants to judge positive, negative, or neutral words, with their right or their left hand.

Participants will be randomly assigned to two equal experimental groups: in the first, the 'word' answer will be made by pressing a 'right' key and in the second, it will be made by pressing a 'left' key.

Each participant will also be presented to all of the stimuli of the task in a random way. Each participant has to give a total of 240 answers: half for 'word' answers and half for 'pseudo-word' answers. Here is the list of words and their valence:

40 positive
40 negative
40 neutral

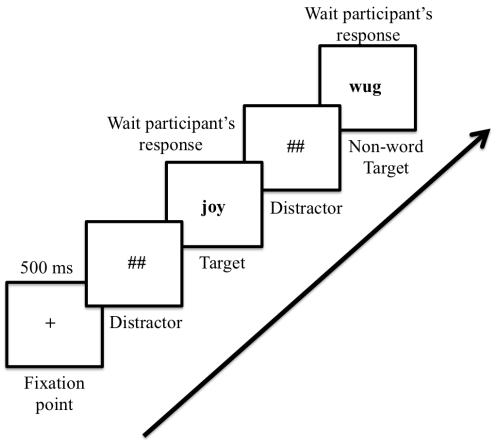
Negative Words	Positive Words	Neutral Words
gun	pet	hay
sin	joy	sum
tax	win	act
pain	joke	echo
jail	cash	boot
debt	hero	oath
riot	lust	veal
slave	waltz	aisle
hell	music	note

enemy	wage	smell
slime	scent	ounce
blame	glory	grade
*ulcer	*jewel	*ether
error	peace	cause
crime	union	dozen
cancer	pillow	butter
poison	salary	deputy
murder	reward	gospel
weapon	circus	aerial
corpse	meadow	liquor
hunger	nature	winter
destroy	victory	apology
missile	cologne	mustard
trouble	culture	segment
dispute	revenue	measure
tobacco	brother	soldier
fatigue	scholar	payment
failure	success	history
torture	victory	finance
measles	diamond	volcano
bother	liberty	sphere
disease	leader	circuit

accident	graduate	medicine
pressure	champion	business
emergency	affection	substance
confusion	education	dimension
misery	thrill	burner
terror	rescue	margin
gloom	berry	trend
*thief	*feast	*rabbi

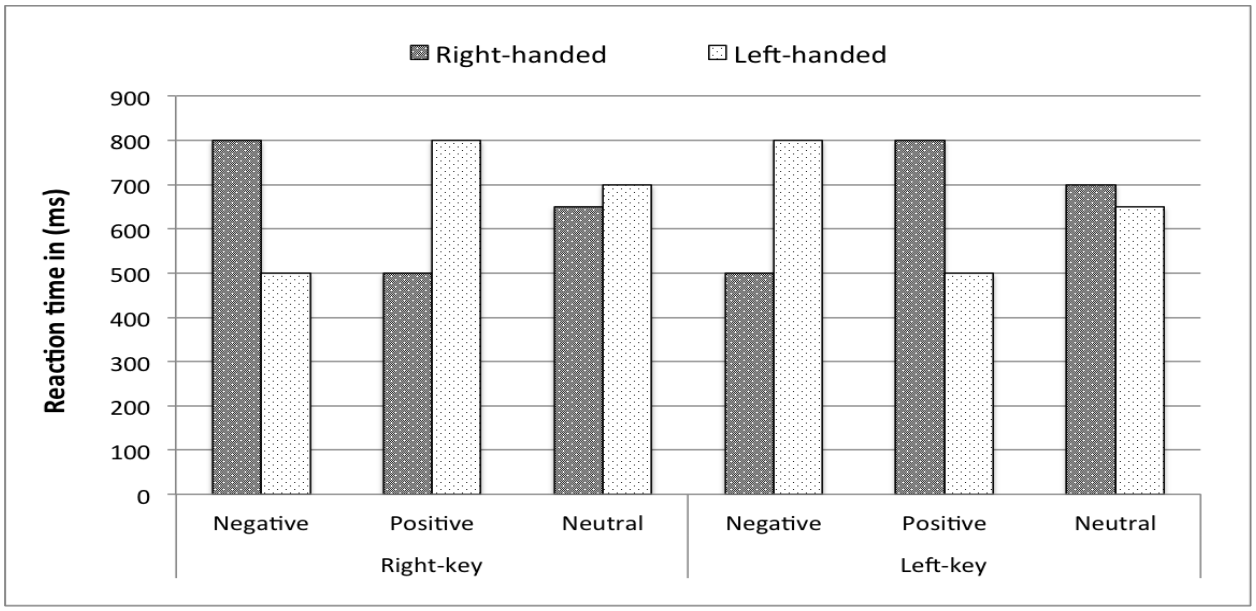
The experiment will be presented with Presentation 14.9 program. The dependent variables will be the reaction times and error rates.

The experiment will take place on an individual basis in an experimental room, where, once participants will be familiar with the task, they will be left alone to do the experiment without any possible disturbing factor. Each trial will begin by the presentation of a central fixation point presented for 500 msec. Then a mask will appear for some amount of randomly assigned msec (to avoid anticipatory responses) and will be followed by a word or non word target to be judged as being a word in English or not. This word will stay on the screen until the participant gives their answer (i.e: "Word" or "pseudo-word"). The following figure illustrates the time course of a trial:



The dependent measure will be reaction time and error rates. What we expect is that the reaction time for "positive" words judged by pressing a right key, would be faster for right-handed participants than left-handed participants. In the other hand, when judging "positive" words by pressing a left key, left-handed participants should be faster than right-handed participants. The opposite pattern should be observed when judging "negative" words. For the "neutral" words we do not expect any

difference in the reaction time between the group of participants. The graph below illustrate our hypothesis:



March, 2nd 2014 - I started to run my experiment! I think participants really enjoyed the task. I took a picture of one of them doing the experiment just to put into my thesis.

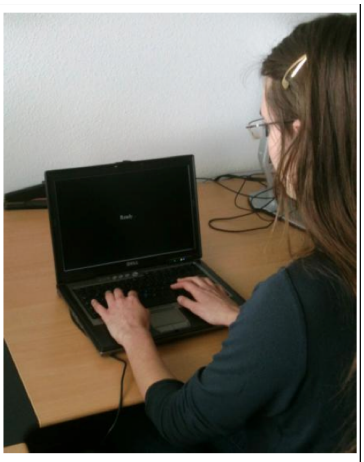


Figure 1 : un des sujets pendant la passation de l'éxpérience.

#March 22nd 2014.
Since I've already tested 20 participants. I will start to take a look on my data, and to conduct my first analysis. Just to know if I have or not a significative effect or If the data is going in the direction of my predictions.

Here is an example of how I organized the data that I collected from participants during the experiment.

	ppnt	hnd	sex	lng	job	job_type	w	val	rt	resp	key
1	p_19	79	f	30	student	0	gun	Negative	1.2165366	1	L
2	p_19	79	f	30	student	0	sin	Negative	0.6053268	1	L
3	p_19	79	f	30	student	0	tax	Negative	0.7768228	1	L

….

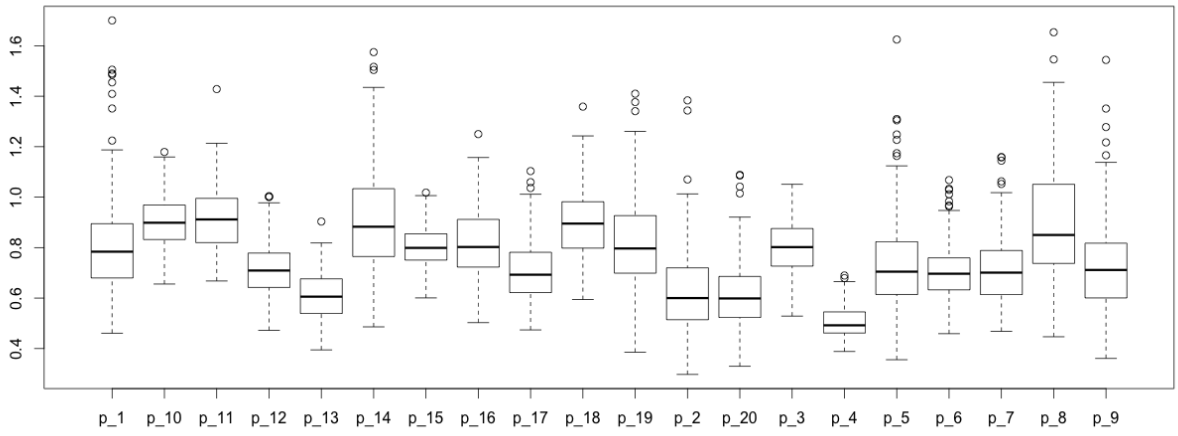
ppnt is the collom with the number of my participant.
#I read somewhere that we have always to exclude any kind of cue that could allow us to identify the identity our participants. Thus attributing them a number will be ok with that.

hnd = the score of the handness that we attributed to the participant following the questionnary that he/she answered.
sex = gender
Ing = the percentage of the time that the participant speaks english in his/her life.
job = Participant's job
job_type = If the participant uses his/her hands to work = 1, if not = 0.
w = the target word that the participant judged
val = the valence of each word
rt = the reaction time of the participant to judge the target word
resp = correctness of participants' response. I've already excluded all the nonwords and left only the real words. Thus, 1 means, the participant judged the target correctly as being a real word, 0 they said it was not a real word (which is wrong).
key = the key associated with the real word (the right answer for all of the data I'll be looking at).

I decided to analyze my data with R.

```
#Preliminary analyses when we've ran 20 participants
read.table("exp03_words_prel.txt",header=T)->ld

#First, we check that the data was read ok
summary(ld)
str(ld)
head(ld)

#next we classify into right and left handed
ld$hnd_bin<-ifelse(ld$hnd>50,"R","L")

#next we classify into mono and bi handed
ld$lang_bin<-ifelse(ld$lng>50,"mono","bi")
```

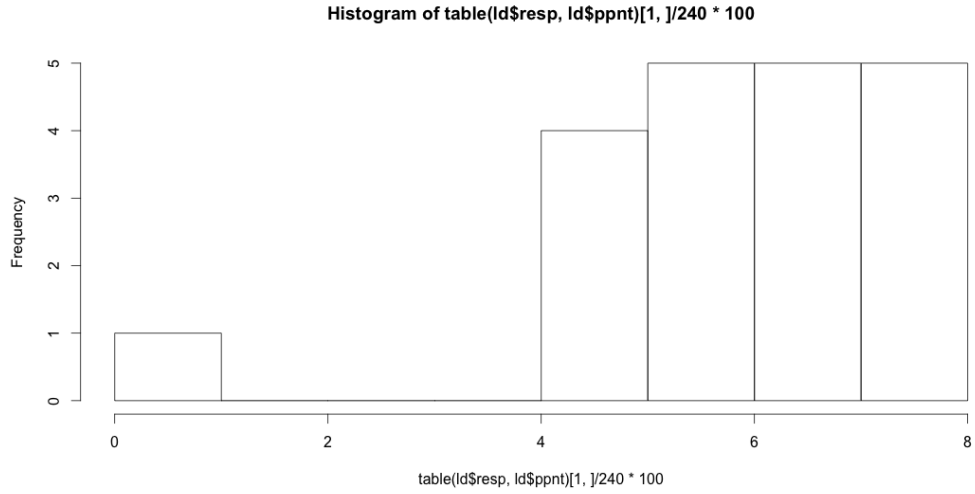
#Check that all the participants are ok
boxplot(ld$rt~ld$ppnt) #ppnt 1 has some outlier really long response times -- on task? maybe exclude?



#p4 has REALLY fast time, who is this guy??? I'm taking him out, he wasn't even thinking...

ld[ld$ppnt!="p_4",]->ld

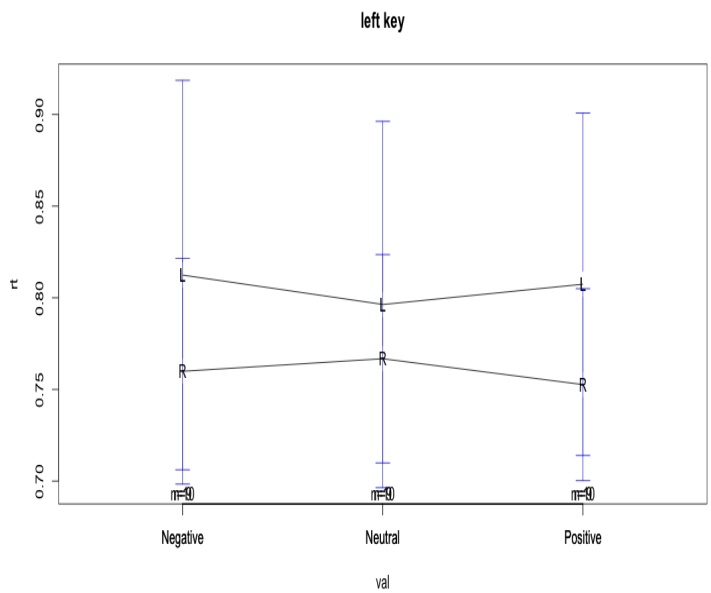
hist(table(ld$resp,ld$ppnt)[1,]/240*100)

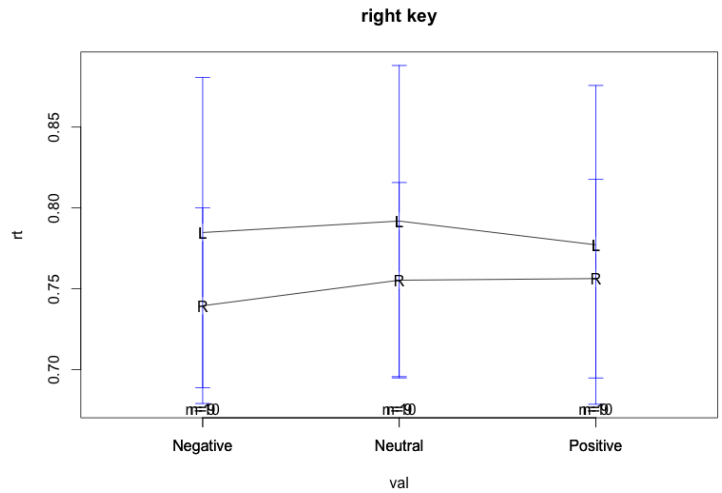


#it looks like people make 4-8% errors, that's great

#now we take only correct trials
ld[ld$resp==1,]->ld

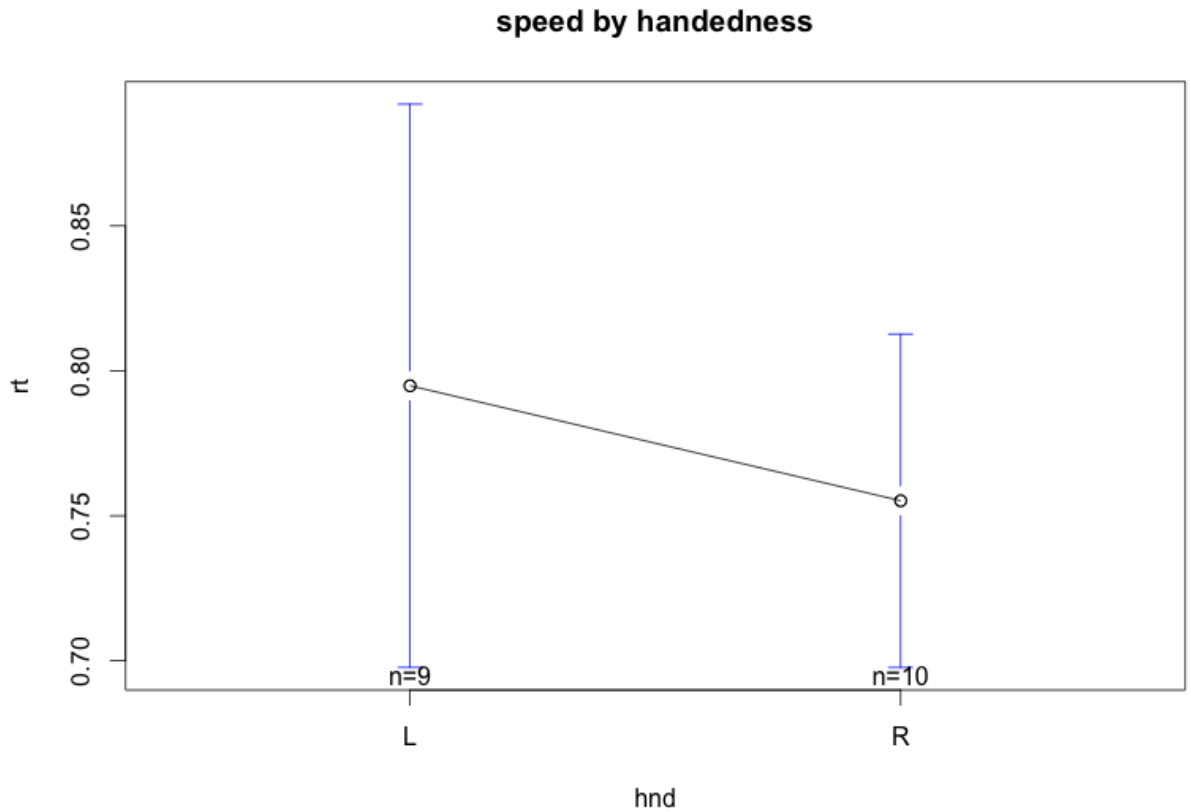
```
aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$job_type,ld$val,ld$ppnt,ld$key),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","job","val","ppnt","key","rt")
#There are too many variables, so we start exploring the data taking 2 or 3 into account at a time
#Looking at the effects of valence, key, and handedness
plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$key=="L"),main="left key")
plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$key=="L"),add=T)
```






```
plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$key=="R"),main="right key")
plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$key=="R"),add=T)
#hmm looks like right handers are overall faster than left handers
#and looks like valence didn't have any effect??
#I also don't see any effect/interaction with key
```

```
# so let's collapse across valence and key since they didn't matter -- actually, let's clean up and have only the variables we are looking at in the table of averages
aggregate(ld$rt,by=list(ld$hnd_bin, ld$ppnt),mean)->temp
colnames(temp)<-c("hnd","ppnt","rt")

plotmeans(rt~hnd,data= temp,main="speed by handedness")
```



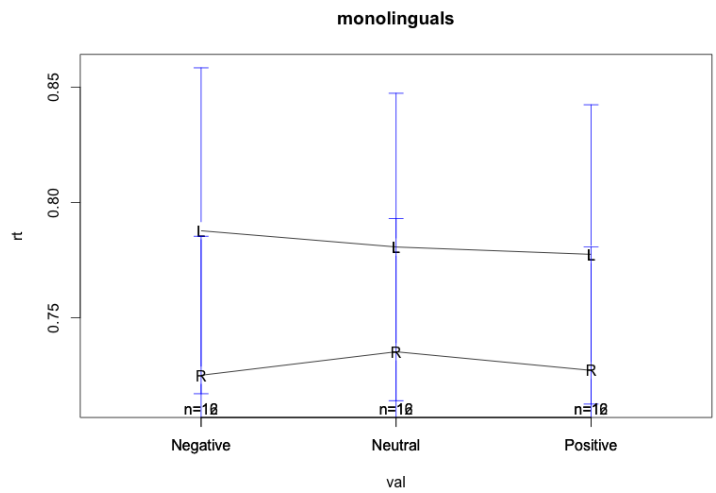

```
t.test(rt~hnd,data= temp)
```

Welch Two Sample t-test

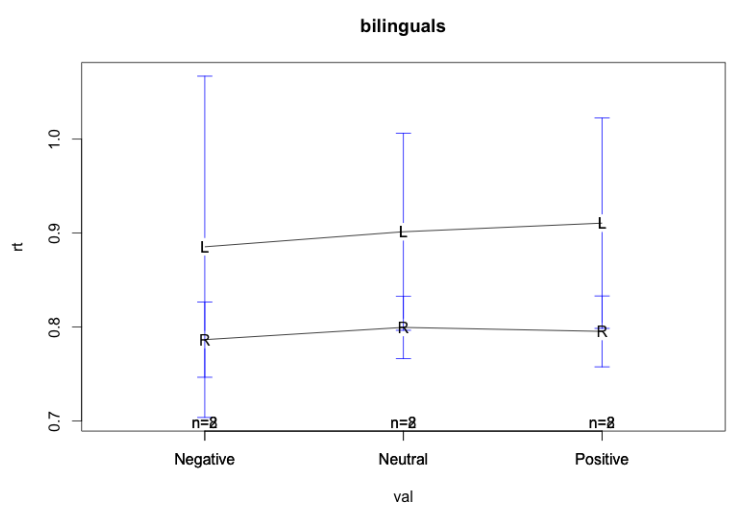
data: rt by hnd
t = 0.8064, df = 13.315, p-value = 0.4342
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.06633798 0.14566561
sample estimates:
mean in group L mean in group R
0.7948471 0.7551832

#not yet significant, perhaps with more subjects...

#We keep exploring, now looking at language
plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$lang=="mono"),main="monolinguals")
plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$lang=="mono"),add=T)



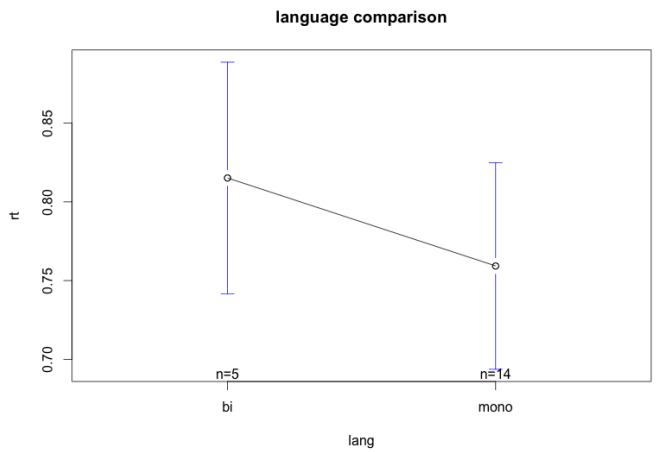
plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$lang=="bi"),main="bilinguals")
plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$lang=="bi"),add=T)



#this analysis replicates the speed difference between left and right handers, and the fact that there are no effects on valence

#if the latter were true, this would be really interesting - it would mean that mono and bilinguals process valence the same!
#let's look at language collapsing across everything else
aggregate(ld$rt,by=list(ld$lang_bin, ld$ppnt),mean)->temp
colnames(temp)<-c("lang","ppnt","rt")

plotmeans(rt~lang,data=temp,main="language comparison")



#Actually no, there IS a language difference: monolinguals are overall faster than bilinguals -- makes perfect sense, but let's check with real statistics

t.test(rt~lang,data=temp)

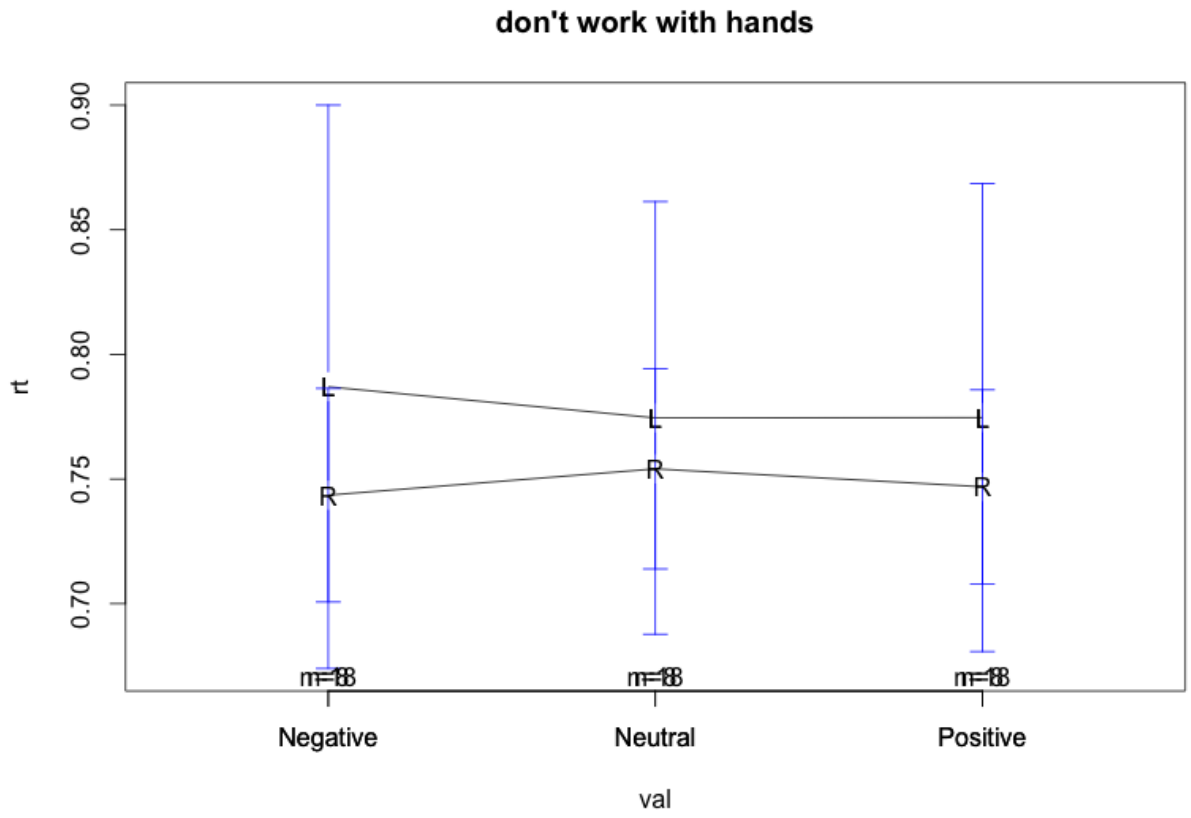
Welch Two Sample t-test

data: rt by lang
t = 1.3878, df = 13.981, p-value = 0.1869
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.03051055 0.14234101
sample estimates:
mean in group bi mean in group mono
0.8151721 0.7592568

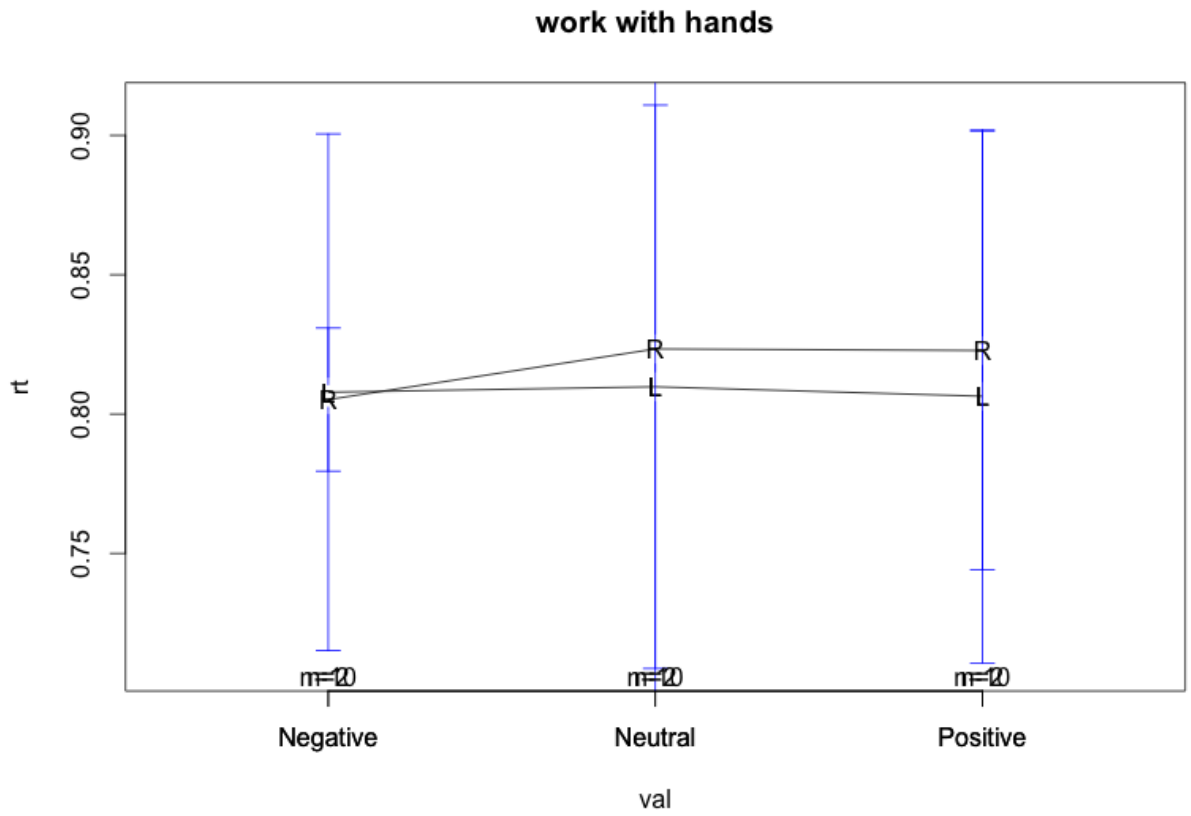
#not sig either, but getting there - cool!

#The only thing left to explore is the type of profession, but since valence and key*handedness didn't matter, I guess it won't play any role - but let's check
plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$job==0),main="don't work with hands")

plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$job==0),add=T)



plotmeans(rt~val,data=meanrts,pch="L",subset=c(meanrts$hnd=="L" & meanrts$job==1),main="work with hands")
plotmeans(rt~val,data=meanrts,pch="R",subset=c(meanrts$hnd=="R"& meanrts$job==1),add=T)



#How interesting, the handedness difference in RT only exists for people who don't work with their hands!
#lets check with proper stats

```
aggregate(ld$rt,by=list(ld$hnd_bin,ld$job_type,ld$ppnt),mean)->temp
colnames(temp)<-c("hnd","job","ppnt","rt")

summary(aov(rt~hnd*job,data= temp))

  Df  Sum Sq  Mean Sq F value Pr(>F)
hnd          1 0.00745 0.007452   0.622  0.443
job          1 0.00519 0.005186   0.433  0.521
hnd:job      1 0.00097 0.000966   0.081  0.780
Residuals   15 0.17964 0.011976
```

#weird -- there is no interaction... but perhaps it's lack of power, so I'll collect some more data

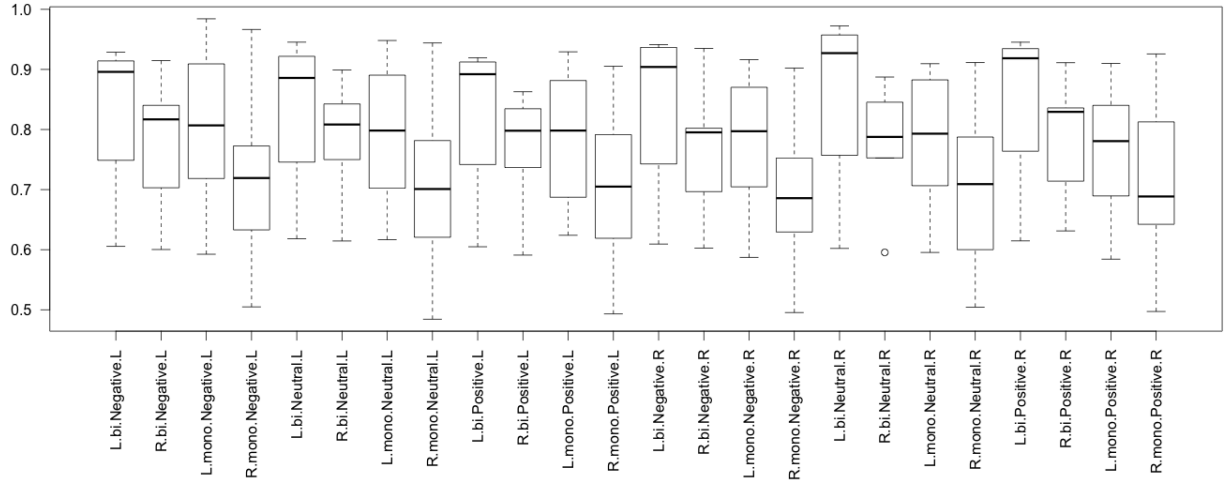
#We're done running subjects! I can do the final analyses now
read.table("exp03_words.txt",header=T)->ld

```
#As usual clean up and add cols first
ld[ld$ppnt!="p_4",]->ld
ld[ld$resp==1,]->ld
ld$hnd_bin<-ifelse(ld$hnd>50,"R","L")
ld$lang_bin<-ifelse(ld$lng>50,"mono","bi")

#then get participant-based averages
aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$job_type,ld$val,ld$ppnt,ld$key),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","job","val","ppnt","key","rt")

#Following Peter's advice, I use a linear regression and stepwise deletion to find the right model
fit<-lm(rt~hnd*lang*job*val*key,data= meanrts)
stepAIC(fit)

best=lm(formula = rt ~ hnd + lang + job + hnd:lang + hnd:job + lang:job , data = meanrts)
summary(best)

Call:
lm(formula = rt ~ hnd + lang + job + hnd:lang + hnd:job + lang:job,
   data = meanrts)

Residuals:
     Min       1Q   Median       3Q      Max
-0.236151 -0.081134  0.007624  0.085762  0.265674

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)   1.03175    0.07661  13.468  < 2e-16 ***
hndR         -0.21703    0.07277  -2.982 0.003289 **
langmono     -0.26770    0.07356  -3.639 0.000364 ***
job          -0.19351    0.07277  -2.659 0.008598 **
hndR:langmono  0.16674    0.06770   2.463 0.014795 *
hndR:job      0.09101    0.05981   1.522 0.129976
langmono:job   0.21467    0.06531   3.287 0.001234 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1173 on 167 degrees of freedom
Multiple R-squared:  0.1467,    Adjusted R-squared:  0.116
F-statistic: 4.783 on 6 and 167 DF,  p-value: 0.0001581


#TERRIFIC this model is significant and accounts for about 11 percent of variance - not too shabby!!
```

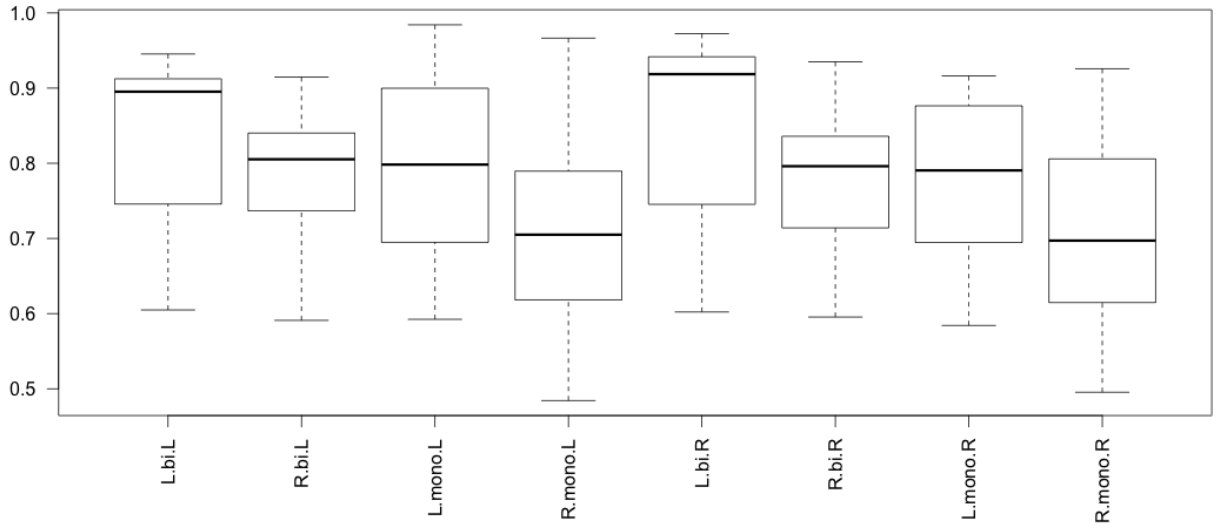
```
#OK, so it looks like:
        #hndR negative estimate: Right-handers are, as I suspected above, FASTER than left-handers
        #langmono negative estimate: again, as I suspected, monolinguals are FASTER than bilinguals
        #also people who work with their hands are faster -- all of this is making perfect sense
        #there are also two interactions, I'm not sure how to explore them so I'll ask Peter

#Yikes Peter said I should have declared repeated measures in that analysis, or averaged over valence
and key since they don't play a role
aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$job_type,ld$ppnt),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","job","ppnt","rt")

fit<-lm(rt~hnd*lang*job,data= meanrts)
stepAIC(fit)
#what, the effect goes away?


#maybe I should have exclude those data, let's start over without exclusions
read.table("exp03_words.txt",header=T)->ld
ld$hnd_bin<-ifelse(ld$hnd>50,"R","L")
ld$lang_bin<-ifelse(ld$lng>50,"mono","bi")

aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$job_type,ld$ppnt),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","job","ppnt","rt")

fit<-lm(rt~hnd*lang*job,data= meanrts)
stepAIC(fit)
best=lm(formula = rt ~ hnd + lang, data = meanrts)
summary(best)

Call:
lm(formula = rt ~ hnd + lang, data = meanrts)

Residuals:
    Min      1Q  Median      3Q     Max
-0.23397 -0.07810  0.02559  0.08367  0.21380

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.84307    0.04919  17.140 4.89e-16 ***
hndR        -0.06557    0.04700  -1.395    0.174
langmono    -0.07103    0.04941  -1.438    0.162
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Residual standard error: 0.1274 on 27 degrees of freedom
Multiple R-squared: 0.1242, Adjusted R-squared: 0.05936
F-statistic: 1.915 on 2 and 27 DF, p-value: 0.1668

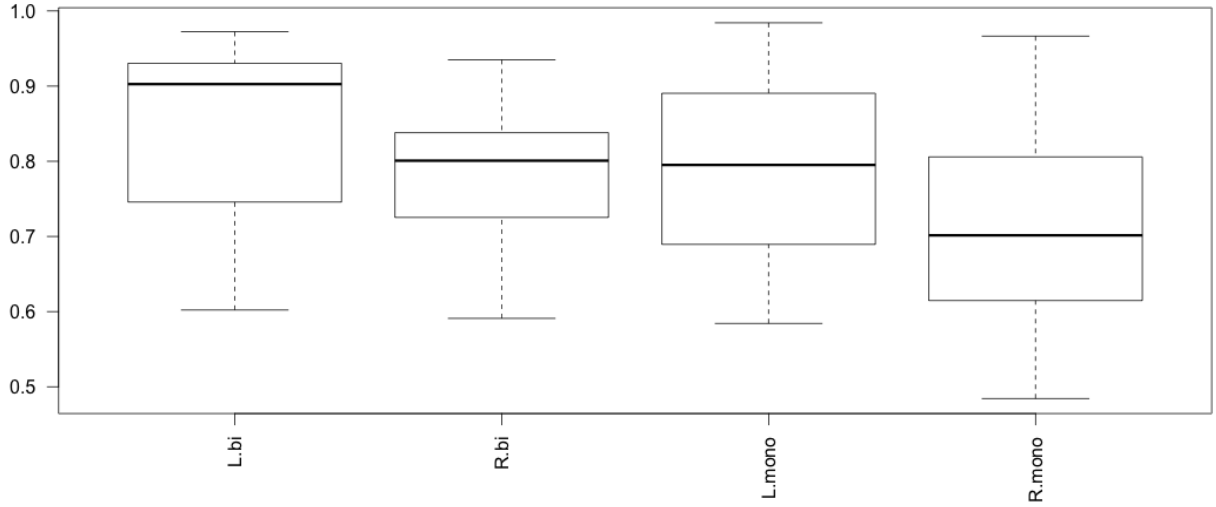
```
#what??? still not significant?
#I don't get it -- let's inspect the data once more

#then get participant-based averages
aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$job_type,ld$val,ld$ppnt,ld$key),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","job","val","ppnt","key","rt")

par(mar=c(10,4,1,0)+0.1)
boxplot(rt~hnd*lang*job*val*key,data=meanrts,las=2) #I definitely see a recurrent pattern...
boxplot(rt~hnd*lang*val*key,data=meanrts,las=2) #yes, its there
```



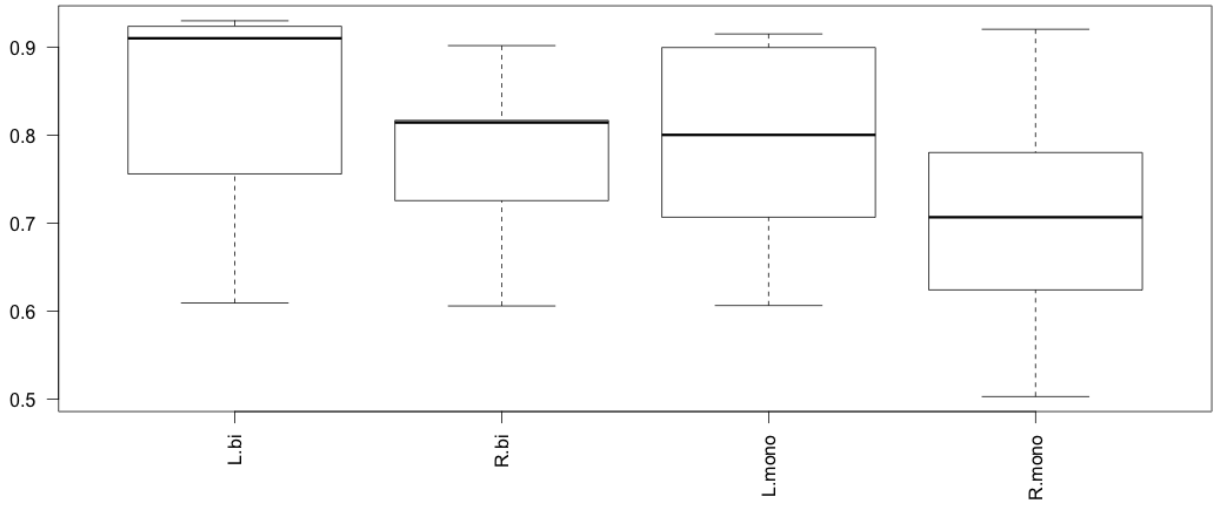

```
boxplot(rt~hnd*lang*key,data=meanrts,las=2) #yes, its there
```



boxplot(rt~hnd*lang,data=meanrts,las=2) #yes, its DEFINITELY there, why doesn't it come out??



#oh maybe it's this repeated measures problem again??
aggregate(ld$rt,by=list(ld$hnd_bin,ld$lang_bin,ld$ppnt),mean)->meanrts
colnames(meanrts)<-c("hnd","lang","ppnt","rt")
boxplot(rt~hnd*lang,data=meanrts,las=2) #no, it's DEFINITELY there!!



t.test(meanrts$rt[meanrts$hnd=="L"& meanrts$lang=="bi"],meanrts$rt[meanrts$hnd=="R"& meanrts$lang=="mono"],alternative="greater")

Welch Two Sample t-test

data: meanrts$rt[meanrts$hnd == "L" & meanrts$lang == "bi"] and meanrts$rt[meanrts$hnd == "R" & meanrts$lang == "mono"]
t = 1.5309, df = 4.928, p-value =
0.0936
alternative hypothesis: true difference in means is greater than 0
95 percent confidence interval:
-0.04310094 Inf
sample estimates:
mean of x mean of y
0.8397467 0.7052698

#still not significant
sum(meanrts$hnd=="L"& meanrts$lang=="bi")#oooh I see - there are only 4 participants in this group
#so we should collect more data

September 1st, 2014
I met with my advisor and we decided to write a paper of our study but only later on, with my results are significant. I don't really know to wich journal I should submit this paper. But I think that in any case, the most important thing should be the impact factor of the journal and I will probably chose the bigger one.
For the time being, he said I should submit to a local conference that is coming up. I got started on the abstract:

François Pignon1, and Patrick Tartampion1,2
1. University of Southern Ile de Groix
2. Institut National de la Recherche en Psycholinguistique Normande

TITLE: When less is more! Monolinguals are faster than bilinguals when processing the valence of words in English.

Language provides as a window into the world, and many studies have shown that your native language shapes your thought. In this study, we further show that it shapes your *actions.* Monolingual and bilingual left- and right-handers were tested on a lexical decision task, with half of the items being words and the other half non-words. Unbeknownst to them, a third of the words had positive valence, a third negative valence, and the final third were neutral. Preliminary analyses of response times (N=30) showed that right-handers responded faster than left-handers and monolinguals faster than bilinguals (t-test p=.09), showing that those who hear fewer languages are quicker to process the valence of words. Additional data are being collected to solidify these results.

Acknowledgments.
This work was funded in part through an ANR grant 1389317XWY; we thank M. Untel for programming the experimental protocol, and Miss des Champs who run the participants. We also thank all of the participants who took part in this study.

October, 2014
It's been challenging to write the paper in English as a French native speaker. I was particularly stuck for the intro and discussion, because the data analysis and methods sections I just have to describe in details what I did. But in order to improuve my english writing skills and to avoid gramatical mistakes when writting the article, I copy some very good transitional sentences from other papers in English. I will use all of that in my paper. Patrick liked the paper, and corrected some of typos.