The data I am currently dealing with is combination of visual and auditory stimulations, to find how the combination of these two stimulations can help!!!

EEG: (the channel position will be the same -> one same channel for all the times) -> this data is to check the “visual stimulation”!!!

32 channels

participants have heard 3 melodies (each melody has 250 ms), and 2 seconds after the three melodies, the participants will respond.

First condition: the participants will see visual stimulation for 2 seconds, and the first melody, and silence, and the second melody and participation respond

Second condition, visual stimulation for 4 seconds,  ‘’

Third,, no visual stimulation,  ‘’

So on and on (8 conditions in total - some has visual stimulations after the first melody, etc….)

2 tasks: simple and manipulation. (as what the previous papers did)

jin > eeg\_visual\_stim > EEG\_results > Behavioural > subject …

<STEPS> - 11 subjects and each subject has usually 8 conditions each

<subject part!!!>

Functional > right click > new subject > subject name (yes default & no, one channel per equisition) > subject > review raw file > import subject xxx with the data type of “EEG: brains vision brain amp (\*.eeg)” (\*we don’t like look at trainings data, only others) >

go to common files and click brain amp channels > right click and add eeg positions and go to colin27 and brain products and select brain products acticap 128  (for each condition) > Check brainamp channels and right click and display sensor >

And, select all conditions and bring to process1 > Run  > 1. pre-process and notch filter and names will be EEG and frequency will be defaulted (60, 120, 180) > (After, select all notch files and bring to process 1 and click run and) pre-process and

2. click band-pass filter > name will be EEG and low frequency will be 0.3 and upper cutoff will be 80 (remove noises below 0.3 and above 80)  and (select all notch\_band files and bring to process1 and)

3. click standardize and re-reference eeg  (select eeg reference channel and “AVERAGE” and name will be EEG ) and

4. click artifacts and ICA components (select all file and name will be EEG, nothing for sort components and number of ICA components as 30 and ICA method as informal) and run (they usually take a lot - around 5 min for each subject >

<each condition>

go to raw file under notch\_band and check the topography and check the eyeblink contaminations  > Open raw files and click artifact > select active projectors and select ICA informal and display component topography > check whether there are any blue or red on the fronted (there should be either blue or red only on front head), and select those components and tick to remove them - \*usually there should not be more than 3 (if there are more, try to take pics and send to Philippe) and click save >

Now, see events box and click “S 8” (20 ms triggers for each) and “S 100” (when two melodies are the same) and “S 112” “S 113-133” (size of the change of tones) > click “S112 - 133” and click Events and  merge groups and enter “D100” for new levels > Now, bring that raw files into process and run and import and import recordings and “import MEG/EEG: Events” > folder name will be (EEG\_visual\_stim > eeg\_results > behavior > subject\_xx [corrresponding] and check the name and if the name is subject\_01\_1\_baseline\_Simple\_rotation\_CCW then the file name would be “bsr”) bsr here (change folder name every time!! important), and event names will “S100, D100”  and the time window as all file, and epoch time as -5000 (ms) unto 3500 (ms) annd untick create one condition for each event type, and add another tool: pre-process and click “DC offset correction” and names as EEG and baseline as (-2.3 ~ -2.2 if the name is “baseline xxxxx” and -4.9 ~ -4.8 if the name is “baseline long stimuli” and -0.1 ~ 0 if the name is “simple/reversed control” or “reversed\_static” or “simple rotation” [when there is no baseline]) and Run (and it creates bsr folder) >

select D100 and S100 all files and move to process1 and run and artifacts and detect bad channels:peak-to-peak > time window will be 0~3.5 and change EEG 0 ~ 250 (microvolt) and select reject the entire trial  (the idea here is in time window 0~3.5, we check the min and max difference is between 0 ~ 250 microvolt and if not, remove them) - checking saccades!!! (\*\*\* if we remove more than 5, make the microvolt threshold higher) >

Also, bring D100 and S100 all files and bring process and click average and average files > click everything and arithmetic average and run (and check topography just in case and check 100ms after 0 and 3 seconds [0.1 s and 3.1 s] and check iPhone pic whether the topography looks similar — 2 seconds visual stimulation shows -2~0 waves) >

Again, select all files of D100 and S 100 bring to process1 and run and click frequency and click time-frequency (morels wavelets) > name will be EEG and click edit (linear will be 1:1:80 and compute measure will be power and output will be “save avg time-frequency maps (across trials)”) and run > and then, run it again  (keep the D100 and S100 in the process1) and click frequency and click time-frequency (morels wavelets) > name will be EEG and click edit (linear will be 1:1:80 and compute measure will be power and output will be “save avg time-frequency maps (across trials)” and now, we click “remove the electroresponse”) and run

>

now bring these two “Avg,power xxx” and “Avg,power,xxx \_02” to process1 and run and standardize and baseline normalization > change baseline (if “baseline XXXX” as -3 ~ -2 and “baseline long” and as -5 ~ -4 and if no baseline word is presented as -1 ~ 0) and run >

and we re-run (with two “Avg,power xxx” and “Avg,power,xxx \_02” in process1) and standardize and baseline normalization  > change baseline to “all file” and run >

Change the names as iPhone pic (avg\_bsr and bsr\_xxx - it depends on the file names - always take the first character for each word) >

copy all these “bsr\_xxx” (not avg\_xxx) and create “group analysis” and paste there (as what iPhone pic shows) >

<File Locations>

jin > eeg\_visual\_stim > EEG\_results > Behavioural > subject … -> to check TXT file

jin > eeg\_visual\_stim > EEG\_results > EEG > subject … -> to run the brainstorm file

<STEPS> - 11 subjects and each subject has usually 8 conditions each

<subject part!!!>

Functional > right click > new subject > subject name (yes default & no, one channel per aqcuisition) > subject > review raw file > import subject xxx with the data type of “EEG: brains vision brain amp (\*.eeg)” (\*we don’t like look at trainings data, only others) >

go to common files and click brain amp channels > right click and add eeg positions and go to colin27 and brain products and select brain products acticap 128 (for each condition) > Check brainamp channels and right click and display sensor (sanity check!!!) >

And, select all conditions and bring to process1 > Run >

1. pre-process and notch filter and names will be EEG and frequency will be defaulted (60, 120, 180) > (After, select all notch files and bring to process 1 and click run and) pre-process and

2. click band-pass filter > name will be EEG and low frequency will be 0.3 and upper cutoff will be 80 (remove noises below 0.3 and above 80) and (select all notch\_band files and bring to process1 and)

3. click standardize and re-reference eeg (select eeg reference channel and “AVERAGE” and name will be EEG) and

4. click artifacts and ICA components (select all file and name will be EEG, nothing for sort components and number of ICA components as 50 and ICA method as informax) and run (they usually take a lot - around 5 min for each subject >

<each condition part!!!>

go to raw file under notch\_band and check the topography and check the eyeblink contaminations > Open raw files and click artifact > select active projectors and select ICA informal and display component topography > check whether there are any blue or red on the fronted (there should be either blue or red only on front head), and select those components and tick to remove them - \*usually there should not be more than 3 (if there are more, try to take pics and send to Philippe) and click save >

(\* Ignore => Now, see events box and click “S 8” (20 ms triggers for each) and “S 100” (when two melodies are the same) and “S 112” “S 113-133” (size of the change of tones))

> click “S112 - 133” and click Events and merge groups and enter “D100” for new levels >

Now, bring that raw files into process and run and import and import recordings and “import MEG/EEG: Events” > folder name will be (EEG\_visual\_stim > eeg\_results > behavior > subject\_xx [corrresponding] and check the name and if the name is subject\_01\_1\_baseline\_Simple\_rotation\_CCW then the file name would be “bsr”) bsr here (change folder name every time!! important), and event names will “S100, D100”

and the time window as all file,

and epoch time as -5000 (ms) unto 3500 (ms)

and untick create one condition for each event type,

and add another tool: pre-process and click “DC offset correction” (Remove DC offset)

and names as EEG

and baseline as (-2.3 ~ -2.2 if the name is “baseline xxxxx”, and -4.9 ~ -4.8 if the name is “baseline long xxx”, and -0.1 ~ 0 if the name is “simple/reversed control” or “reversed\_static” or “simple rotation” [when there is no baseline]) and Run (and it creates bsr folder) >

select D100 and S100 all files and move to process1

and run and artifacts and "detect bad channels:peak-to-peak" >

time window will be 0~3.5 and change EEG 0 ~ 250 (microvolt)

and select reject the entire trial

and run (the idea here is in time window 0~3.5, we check the min and max difference is between 0 ~ 250 microvolt and if not, remove them) - checking saccades!!! (\*\*\* if we remove more than 5, make the microvolt threshold higher) >

Also, bring D100 and S100 all files and bring process and click average and average files > click everything and arithmetic average and run (and check topography just in case and check 100ms after 0 and 3 seconds [0.1 s and 3.1 s] and check iPhone pic whether the topography looks similar — 2 seconds visual stimulation shows -2~0 waves) >

Again, select all files of D100 and S100 bring to process1 and run

and click frequency and click time-frequency (morlet wavelets) > name will be EEG and click edit (linear will be 1:1:80 and "compute the following measure" will be power

and output will be “save avg time-frequency maps (across trials)”)

and (untick "remove the evoked response") and run >

and then, click run again (keep the D100 and S100 in the process1) and click frequency and click time-frequency (morels wavelets) > name will be EEG

and click edit (linear will be 1:1:80 and compute measure will be power and output will be “save avg time-frequency maps (across trials)”

and now, we tick “remove the evoked response” option and run >

now bring these two “Avg,power xxx” and “Avg,power,xxx \_02” to process1 and run and standardize and baseline normalization > change baseline (if “baseline XXXX” as -3 ~ -2 ,and “baseline long” and as -5 ~ -4 ,and if no baseline word is presented as -1 ~ 0) and run >

and we re-run (with two “Avg,power xxx” and “Avg,power,xxx \_02” in process1) and standardize and baseline normalization > change baseline to “all file” and run >

Change the names as iPhone pic (avg\_bsr and bsr\_xxx - it depends on the file names - always take the first character for each word) >

copy all these “bsr\_xxx” (not avg\_xxx) and create “group analysis” and paste there (as what iPhone pic shows) >

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<Analysis>

Idea:

1) blsrr (rotation visual for four seconds and then some music and then 2 second break [In the last analysis, we would break these 2 seconds into 8 time windows, as 2 seconds

is relatively big] and then music) 2) blsrs (everything the same as blsrr but use static visual stimulation)

3)rc (everything the same as blsrr but no visual stimulation) -> So, we compare 1 vs 2, 2 vs 3, 1 vs 3. (we hope to see that when

rotating visual stimulation, there is dorsal stream

affected - both visual stimulation will affect visual cortex though. After that, we hope to see that 1 vs 3 performs better than 2 vs 3!)

blsrr -> average all "TF\_full | z score" and "TF evoked removed | z score" and "TF full | z score all file" and "TF evoked removed |z score all file"

Repeat these for RC and blsrs

\*so four averages for these three conditions

Bring all four avg from blsrr and rc in process 2 (each line should correspond each other) -> process -> difference -> difference: A-B (call alpha)

Bring all four avg from blsrs and rc in process 2 (each line should correspond each other) -> process -> difference -> difference: A-B (call beta)

Bring all four avg from blsrr and blsrs in process 2 (each line should correspond each other) -> process -> difference -> difference: A-B

Now, do compare alpha and beta with difference

Bring all into process2 "TF\_full | z score" of blsrr and "TF\_full | z score" of rc, and process -> test -> fieldtrip: ft\_freqstatistics -> one\_tailed(+) and time window 0.75 - 1

And, do the same thing, but change the time window 1 - 1.25

And, do the same thing, but change the time window 1.25 - 1.5

....

Do this 0.25 interval upto 2.5 - 2.75

Bring all into process2 "TF\_full | z score" of blsrs and "TF\_full | z score" of rc, and process -> test -> fieldtrip: ft\_freqstatistics -> one\_tailed(+) and time window 0.75 - 1

And, do the same thing, but change the time window 1 - 1.25

And, do the same thing, but change the time window 1.25 - 1.5

....

Do this 0.25 interval upto 2.5 - 2.75

Bring all into process2 "TF\_full | z score" of blsrr and "TF\_full | z score" of blsrs, and process -> test -> fieldtrip: ft\_freqstatistics -> one\_tailed(+) and time window 0.75 - 1

And, do the same thing, but change the time window 1 - 1.25

And, do the same thing, but change the time window 1.25 - 1.5

....

Do this 0.25 interval upto 2.5 - 2.75

Do all these for "TF evoked removed | z score" and "TF full | z score all file" and "TF evoked removed |z score all file"

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<Analysis2>

baseline: visual stimulation for 2 seconds -> melodies -> break -> melodies -> respond

baseline long: visual stimulation for 4 seconds -> the same....

rc: melodies -> break -> reversed melodies -> respond

sc: melodies -> break -> melodies -> respond

rr: melodies -> rotated visual stimulation -> reversed melodies -> respond

1. Do the same analysis for 7 more! (rc vs sc, brs vs rc, rr vs rc, rs vs rc, rr vs rs, brr vs rc, and brr vs brs)

2. Bring Avg of 8 conditions from 11 subjects, (so, average across subjects for each condition, meaning that for example, for brr, we bring avg of brr condition from all subjects and avg them) and average them again, and check all of them whether the stimulation works fine!

3. Take "TF\_full | zscore" for all subjects for each condition (we need three to do this for three conditions)

-> bring to process -> avg time -> avg time with corresponding time window -> export to matlab (iphone pic)

-> Then, change matlab current directory to jin/eeg\_visual\_stim/data\_freq, and then, save those files in workspace

that were exported into "data\_freq" folder.

Do them for all 8 time windows for blsrr, blsrs, rc

And, do it for others for "TF evoked removed | z score" and "TF full | z score all file" and "TF evoked removed |z score all file"

4. Bring avg of specific conditions to process 2 (11 subjects condition A vs 11 subjects condition B)

-> test -> fieldtrip:ft\_timelockstatistics and change time window

and do 8 time windows and "average over time" and paired test and one tailed

for

blsrr vs rc, blsrs vs rc, blsrr vs blsrs, rc vs sc

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<Analysis3>

bring all D100, S100 > connectivity > phase locking value N \* N > 0.75 ~ 2.75, -4 ~ 0, and only theta with 3 to 9 and concatenate > run

for all conditions for every subject

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<Analysis4>

2.

And, add -2 and 0 baseline for PLV for six conditions (exclude long stimulation)

3. Pilot study ads

Need around 15 people

EEG and TMS

7 times of 45 min session.

First week of Nov

280

No history of Epilepsy

No musical training (not much of formal training)

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1.

For every subject and condition,

Coherence N\*N

Phase Transform Entropy N\*N (keep all of freq, not just theta)

for baseline (-4 0) and retnetion (0.75 2.75)

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<EEG pilot study>

I have to book the TMS rooms

Seven sessions with four EEG (1, 3, 5, 7) - 45~50 min per each session - 20~25 to prepare for EEG so when we would do EEG it would take longer! + Each session will be $40 and pay at the end + Consent form / whether they want coies + They will be contacted next week after each session finishes for all 15 ppl + For 2,3,4,5,6 sessions, TMS will happen together!

More than 24 ~ 72 hours between each session!!! (so, Each session 2-3 days for session 2 ~ 7!) -> session 1 ~ session 2 can be more delays like upto 1 month

session1 is baseline.

session2 is only TMS training.

session3 is TMS and EEG training.

session4 is only TMS training.

session5 is TMS and EEG training.

session6 is only TMS training.

session7 is EEG.

Will listen to three tones, and remember them, and wait for 5 seconds, and will show visual showing that will be matched with the second melody, listen to the three tones

(They do 15 trials/practice)

There are no visual rotating/random shepard form for this study!

{Practice}

left computer -> palbouy folder -> TMS\_training -> manipulation\_task -> practice\_training.sce (For 15 trainings, they will do it with headphones, but when they do it with EEG, they are not going to use headphones) -> left click (match) or right click (non-match)

{First session}

Alcohol for hair + left nose + left 눈 밑 눈 위 + skinpure (for skin cleaning - nose)

-> measure the head size

-> use cap with letters (black dot should be on the front) + CZ on the middle (for both left/right and top/back)

-> skinpure (for skin cleaning - nose) & put stickers left 눈 밑 눈 위 on 얇은 쪽 for reference and ground check

-> for data check with gel skinpure with Q-tip in each electrode to clean the hair and remove hair & alcohol in bowl + abralyt with syringe, and press it after having gels & try not to have gels outside!

-> blue on the left and red on the right for earplugs, and put it in ear for 10seconds and wait ->

Don't blink (blink when click the button)

Dont' move

Let them sit at the back chair so i can see the eyeblinks

{EEG}

right computer

Two amplifiers with connections of two 1-32 and 33 - 64 with the right head size

Finsih 5 people for the basline first, and then do full sessions for 1 person. -> to check parameters