**SAS Codes and SAS Macros**

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\*I. Calculate Intracluster Correlation Coefficients (ICC) \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

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\*1. Between-Ear, Within-Person ICC;

**%macro** run\_ICC1(freqnum,ear,noise);

ods text= "&freqnum.|&ear.|Yes";

\*if noise is not a covariate;

%if &noise.=No %then %do;

proc mixed noclprint ASYCOV data=HTData\_filtered;

class id\_freq;

model threshold =/s;

random id\_freq;

run;

%end;

%else %do;

proc mixed noclprint ASYCOV data=HTData\_filtered;

class id\_freq;

model threshold = &noise./s;

random id\_freq;

run;

%end;

**%mend** run\_ICC1;

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

\*\*\*\*\* All subjects, specific freq \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

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\* freqnum: specifies a frequency level

\* ear: specify ear side if necessary

\* noise: include a noise covariate?;

**%macro** run\_ICC1\_models(noise,lbl);

ods rtf file="&root.\sasout\&lbl.\_&sysdate..rtf";

ods text= "Frequency|Ear|Reliable?";

%***run\_ICC1***(**500**,Right,&noise.);

%***run\_ICC1***(**500**,Left,&noise.);

ods rtf close;

**%mend** run\_ICC1\_models;

\*1 & 2 run mixed effects models;

%***run\_ICC1\_models***(No,I\_1\_ICC);

%***run\_ICC1\_models***(meanAmbientNoise,I\_2\_ICC\_meannoise); \*fka I\_3\_...;

\*2 Between-Ear, add day, Within-Person ICC, for both ears reliable ONLY;

**%macro** run\_ICC2(freqnum); \*fka 1.5...;

proc mixed noclprint ASYCOV data=HTData\_filtered2;

class id\_freq ear\_side;

model threshold =/s;

random id\_freq ear\_side(id\_freq);

ods select CovParms AsyCov;

run;

ods text= "&freqnum.|Both|Yes\_eareffect";

**%mend** run\_ICC2;

ods rtf file="&root.\sasout\I\_3\_ICC\_&sysdate..rtf"; \*fka 1.5...;

ods text= "Frequency|Ear|Reliable?";

%***run\_ICC2***(**500**);

ods rtf close;

\*3 Between-Ear, add day, Within-Person ICC, for both ears reliable ONLY;

**%macro** run\_ICC3(freqnum); \*fka 1.5...;

ods text= "&freqnum.|Both|Yes\_eareffect";

proc mixed noclprint ASYCOV data=HTData\_filtered2;

class id\_freq ear\_side meas\_day;

model threshold =/s;

random id\_freq ear\_side(id\_freq) meas\_day(id\_freq);

run;

**%mend** run\_ICC3;

ods rtf file="&root.\sasout\I\_3\_ICC\_&sysdate..rtf"; \*fka 1.5...;

ods text= "Frequency|Ear|Reliable?";

%***run\_ICC3***(**500**);

ods rtf close;

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\*Use absolute value of difference (in dB) between repeated measures \*\*\*\*\*\*\*;

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\*1. Summary statistics for diff in dB for repeated measurements;

proc means data=HTData\_Filtered min max mean STD;

var difference;

run;

proc univariate data=HTData\_Filtered;

var difference;

output pctlpts=**25** **50** **75** pctlpre=diffpctl\_;

run;

\*2. Report % outside +/-5dB (denoted as y1) and % outside +/-10dB (denoted as y2);

**%mend** difference\_summaries\_byfreq;

**%macro** difference\_summaries(freqnum);

%***difference\_summaries\_byfreq***(&tbl.,&freqnum.,Right,Yes);

%***difference\_summaries\_byfreq***(&tbl.,&freqnum.,Left,Yes);

**%mend** difference\_summaries;

**%macro** difference\_summaries(tbl);

ods rtf file="&root.\sasout\II\_Db\_diff\_&tbl.\_&sysdate..rtf";

ods text= "Frequency|Ear|Reliable?";

%***difference\_summaries\_byfreq***(&tbl.,**500**,Right,Yes);

%***difference\_summaries\_byfreq***(&tbl.,**500**,Left,Yes);

ods rtf close;

**%mend** difference\_summaries;

%***difference\_summaries***(repeated\_w\_rel);

%***difference\_summaries***(sameday\_w\_rel);

%***difference\_summaries***(diffday\_w\_rel);

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

\*IV. Relationship between noise level and within-person/between repeated \*\*;

\* measures variation based on linear regression. \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

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**%macro** GEE\_IV\_1(suffix,noise);

\*1. Pool all together ear and freq together;

ods text= "&suffix.|&noise.";

proc genmod data=HTDATA\_sorted order=data;

class ID frequency;

model difference = &noise. frequency;

repeated subject=id / TYPE=INDEP;

run;

**%mend** GEE\_IV\_1;

ods rtf file="&root.\sasout\IV\_GEE\_1\_&sysdate..rtf";

ods text= "suffix|noise";

%***GEE\_IV\_1***(w\_rel,Avg\_meanAmbientNoise);

%***GEE\_IV\_1***(w\_rel,Max\_meanAmbientNoise);

%***GEE\_IV\_1***(w\_rel,Max\_maxAmbientNoise);

ods rtf close;

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\*V. Examine Decibel data vs gold standard \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*;

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**%macro** spear\_corr(freqnum);

ods text= "&freqnum.||Both";

proc corr data=dat\_filtered SPEARMAN cov plots=matrix;

var avg\_threshold\_NHS;

with avg\_threshold\_GS;

run;

ods text= "&freqnum.||Left";

proc corr data=dat\_filtered2(where=(ear\_side="Left")) SPEARMAN cov plots=matrix;

var avg\_threshold\_NHS;

with avg\_threshold\_GS;

run;

ods text= "&freqnum.||Right";

proc corr data=dat\_filtered2(where=(ear\_side="Right")) SPEARMAN cov plots=matrix;

var avg\_threshold\_NHS;

with avg\_threshold\_GS;

run;

**%mend** spear\_corr;

ods rtf file="&root.\sasout\V\_spearmancorr\_&sysdate..rtf";

ods text= "frequency||Ear";

%***spear\_corr***(**500**);

ods rtf close;

\*Linear regression: GS = beta0 + beta1 \* avg(repeated measures) + beta2 \* noise + beta3 \* avg(repeated measures) \* noise + randomeff\_individual

\* Separated by frequency

\* One with noise, one without noise

\* Report intercept (hopefully 0);

**%macro** GEE\_V\_2(freqnum,noise);

ods text= "avgNHS|&freqnum.|&noise.";

%if &noise.=NA %then %do;

proc genmod data=DATA\_sorted order=data;

class ID;

model threshold\_GS = avg\_threshold\_NHS;

repeated subject = ID / TYPE=EXCH; \*corr bw all time points are exchangeable;

run;

%end;

%else %do;

proc genmod data=DATA\_sorted order=data;

class ID;

model threshold\_GS = avg\_threshold\_NHS &noise. avg\_threshold\_NHS\*&noise.;

repeated subject = ID / TYPE=EXCH; \*corr bw all time points are exchangeable;

run;

%end;

**%mend** GEE\_V\_2;

**%macro** GEE\_V\_2\_Setup(freqnum);

%***GEE\_V\_2***(&freqnum.,NA);

%***GEE\_V\_2***(&freqnum.,Avg\_meanAmbientNoise);

**%mend** GEE\_V\_2\_Setup;

ods rtf file="&root.\sasout\V\_GEE\_&sysdate..rtf";

ods text= "suffix|frequency|noise";

%***GEE\_V\_2\_Setup***(**500**);

ods rtf close;

**proc** **sort** data=out.COMBData\_avgNHS; by frequency avg\_threshold\_NHS threshold\_GS; **run**;

%***sas\_2\_xl***(out.COMBData\_avgNHS,V\_COMBData\_avgNHS.xlsx);