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clear; clc; close all;

%-----
% Variable
%-----

parIndexSet    = [1 2];

ROINameSet     = ["HPC" "aPFC" "dIPFC" "HPC1" "HPC2" "HPC3" "HPC4" "EVC" "LOC"]

nStims         = 40; % Number of tested stimuli

nRuns          = 4; % Number of repetitions (1 run = 1 learning + 1 retrieval)

tasktype       = 'RET';

dir_PatternCorr = './Pattern_Correlation/';
%% Load Behavioral data and Correlation Data
AllCorr = cell(1,length(parIndexSet));
TotData = cell(nRuns,length(parIndexSet));

for parIndex = parIndexSet
    cPar = parIndex;

    for fileInd = 1:nRuns
        cFile =
strcat('./Behavior/P00',num2str(cPar),'/Retrieval/run',num2str(fileInd),'_RET_Data.txt'); %
Each participant's behavioral data file name
        cData = fopen(cFile,'r');
        formatSpec = '%s %s %s %s %s %s %s %s';
        A = textscan(cData,formatSpec);

        % Each file is (Trials * 7) matrix. 40*7 for this Study.
        % 1st Column : Object number, 6th Column : Correctness of response
        % 7th Column : Confidence Rating

        for cObject = 1:nStims
            for i = 1:8
                TotData{fileInd,parIndex}(cObject,i) = A{1,i}(cObject,1);
            end
        end
    end
end

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PatternCorrName = strcat(dir_PatternCorr,'P00',num2str(cPar),'_',tasktype,'.cor.mat');
load(PatternCorrName);

AllCorr{1,parIndex} = All_corrMatrix;

% Load data containing correlation data
% AllCorr is a matrix containing correlation data of ROIs of
% participants. It is 1*Participants cell.
% Each cell is Trials*Trials*ROIs matrix (160*160*9 for this study)

end

HCcorr = []; % Matrix for High-Confidence Within-Comparison Corresponding indices
LCcorr = []; % Matrix for Low-Confidence Within-Comparison Corresponding indices
HCcorr2 = []; % Matrix for High-Confidence Between-Comparison Corresponding indices
LCcorr2 = []; % Matrix for Low-Confidence Between-Comparison Corresponding indices

for parInd = 1:length(parIndexSet)
    cPar = parIndexSet(parInd);

    %% Define subjective range

    % Define Max and Min Confidence Range of CR trials
    minCF = 100;
    maxCF = 0;
    for trialInd = 1:160
        objnum = str2double(cell2mat(TotData{1,cPar}{mod(trialInd-1,40)+1,1})); % Object
        presented in the trial
        score = str2double(cell2mat(TotData{fix((trialInd-1)/40)+1,cPar}{mod(trialInd-
        1,40)+1,6})); % Score of response. 1 : Correct, 0: Wrong, -1 : No response
        conf = str2double(cell2mat(TotData{fix((trialInd-1)/40)+1,cPar}{mod(trialInd-
        1,40)+1,7})); % Confidence Rating (0 ~ 100)
        isnew = 0; % indicator representing whether the object was learned or not (0: learned, 1:
        non-learned)
        if objnum > 40 || mod(objnum,2) == 0 % If current object is non-learned
            isnew = 1;
        end
        if conf == 0 || score == -1 % Exclude trials if confidence rating is 0 or there was no
        response
            continue
        end
        if score == 1 && isnew == 1 % Check if it is CR trial
            if conf<minCF

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        minCF = conf; % Searching min Confidence rating
    end
    if conf > maxCF
        maxCF = conf; % Searching max Confidence rating
    end
end
end
minRan = [minCF, minCF+10, minCF+20]; % Low-Confidence Range
maxRan = [maxCF-20, maxCF-10, maxCF]; % High-Confidence Range

if minCF+20 >= maxCF-20 % Exclude the participant if the min and max confidence ranges
overlap
    continue
end

%% CR-Hit correlation Analysis
Temp1 = [];
Temp2 = [];
Temp3 = [];
Temp4 = [];
for trialInd1 = 1:160 % Trial1 (CR trial)
    objnum = str2double(cell2mat(TotData{fix((trialInd1-1)/40)+1, cPar}{mod(trialInd1-
1,40)+1,1})); % Object presented in the trial
    score = str2double(cell2mat(TotData{fix((trialInd1-1)/40)+1, cPar}{mod(trialInd1-
1,40)+1,6})); % Score of response. 1 : Correct, 0: Wrong, -1 : No response
    conf = str2double(cell2mat(TotData{fix((trialInd1-1)/40)+1, cPar}{mod(trialInd1-
1,40)+1,7})); % Confidence Rating (0 ~ 100)
    isnew = 0;
    if objnum > 40 || mod(objnum,2) == 0
        isnew = 1;
    end

    if conf == 0 || score == -1
        continue
    end
    C1 = [];
    T1 = [];
    T2 = [];
    T3 = [];
    T4 = [];

    if (score == 1 && isnew == 1) && objnum < 41 % Check if trial1 is CR trial
        %% Within-Comparison
        for trialInd2 = 1:160 % Trial2 (Hit trial)

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        objnum2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-1,40)+1,1}));
        score2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-1,40)+1,6}));
        conf2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-1,40)+1,7}));
        isnew2 = 0;
        if objnum2 > 40 || mod(objnum2,2) == 0
            isnew2 = 1;
        end

        if objnum ~= objnum2 + 1 % Check if the object category is same (Within-Comparison)
            continue
        elseif conf2 == 0
            continue
        elseif isnew2 == 1 || score2 ~= 1 % Check if trial2 is Hit trial
            continue
        end

        CI = cat(1,CI,squeeze(AllCorr{1,cPar}{trialInd1, trialInd2, :})); % Corresponding Index between trial1(CR) & trial2(Hit)
        if isempty(find(maxRan == conf)) == 0 % If confidence belongs to High-Confidence range
            T1 = cat(1,T1,CI); % Stack corresponding indices of High-Confidence CR trials
        elseif isempty(find(minRan == conf)) == 0 % If confidence belongs to Low-Confidence range
            T2 = cat(1,T2,CI); % Stack corresponding indices of High-Confidence CR trials
        end
    end

    if isempty(CI) == 1
        continue
    end

    if isempty(find(maxRan == conf)) == 0
        Temp1 = cat(1,Temp1,nanmean(T1,1)); % Stacking mean corresponding index of High-Confidence within-comparison
    elseif isempty(find(minRan == conf)) == 0
        Temp2 = cat(1,Temp2,nanmean(T2,1)); % Stacking mean corresponding index of Low-Confidence within-comparison
    end

    %% Between-Comparison

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for trialInd2 = 1:160
    t = [];
    objnum2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-
1,40)+1,1})));
    score2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-
1,40)+1,6})));
    conf2 = str2double(cell2mat(TotData{fix((trialInd2-1)/40)+1,cPar}{mod(trialInd2-
1,40)+1,7})));
    isnew2 = 0;
    if objnum2 > 40 || mod(objnum2,2) == 0
        isnew2 = 1;
    end

    if objnum == objnum2 + 1 % Check if the object is different (Between-Comparison)
        continue
    end

    if conf2 == 0
        continue
    elseif score2 ~= 1 || isnew2 == 1
        continue
    end

    CI = cat(1,CI,squeeze(AllCorr{1,cPar}{trialInd1, trialInd2, :})');
    if isempty(find(maxRan == conf)) == 0 % If confidence belongs to High-Confidence
range
        T3 = cat(1,T3,CI); % Stack corresponding indices of High-Confidence CR trials
    elseif isempty(find(minRan == conf)) == 0 % If confidence belongs to Low-Confidence
range
        T4 = cat(1,T4,CI); % Stack corresponding indices of Low-Confidence CR trials
    end
end

if isempty(CI) == 1
    continue
end

if isempty(find(maxRan == conf)) == 0
    Temp3 = cat(1,Temp3,nanmean(T3,1)); % Stacking mean corresponding index of High-
Confidence between-comparison
elseif isempty(find(minRan == conf)) == 0

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        Temp4 = cat(1,Temp4,nanmean(T4,1)); % Stacking mean corresponding index of Low-
Confidence between-comparison
    end
end
end

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    if isempty(Temp1) == 1 || isempty(Temp2) == 1 % Skip the subject if there is no High- or
Low-Confidence within-comparison case
        continue
    end

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    if isempty(Temp3) == 1 || isempty(Temp4) == 1 % Skip the subject if there is no High- or
Low-Confidence between-comparison case
        continue
    end

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% Exclude the participant if any of 4 conditions ( High-CF
% Within-Comparison, Low-CF Within-Comparison, High-CF Between-
% Comparison, Low-CF Between-Comparison) is empty.

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Temp1 = nanmean(Temp1,1);
Temp2 = nanmean(Temp2,1);
Temp3 = nanmean(Temp3,1);
Temp4 = nanmean(Temp4,1);
HCcorr = cat(1,HCcorr,Temp1(:,:)); % Store mean Correlation Value for High-Confidence
Within-Comparison of each participants
LCcorr = cat(1,LCcorr,Temp2(:,:)); % Store mean Correlation Value for Low-Confidence
Within-Comparison of each participants
HCcorr2 = cat(1,HCcorr2,Temp3(:,:)); % Store mean Correlation Value for High-Confidence
Between-Comparison of each participants
LCcorr2 = cat(1,LCcorr2,Temp4(:,:)); % Store mean Correlation Value for Low-Confidence
Between-Comparison of each participants

end

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%% Plots

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tresults = zeros(8,length(ROINameSet));
tresults2 = zeros(8,length(ROINameSet));
ROIs = [2,3];
for ROIInd = ROIs
    [q, p, ci, stat] = ttest(HCcorr(:,ROIInd),LCcorr(:,ROIInd));
    tresults(1:2,ROIInd) = [q;p];
    [q, p, ci, stat] = ttest(HCcorr2(:,ROIInd),LCcorr2(:,ROIInd));

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tresults(3:4,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(HCcorr(:,ROIInd),HCcorr2(:,ROIInd));
tresults(5:6,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(LCcorr(:,ROIInd),LCcorr2(:,ROIInd));
tresults(7:8,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(HCcorr(:,ROIInd));
tresults2(1:2,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(LCcorr(:,ROIInd));
tresults2(3:4,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(HCcorr2(:,ROIInd));
tresults2(5:6,ROIInd) = [q;p];
[q, p, ci, stat] = ttest(LCcorr2(:,ROIInd));
tresults2(7:8,ROIInd) = [q;p];

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Y =
[nanmean(HCcorr(:,ROIInd)),nanmean(LCcorr(:,ROIInd));nanmean(HCcorr2(:,ROIInd)),nanmean(
LCcorr2(:,ROIInd))];
Z =
[nanstd(HCcorr(:,ROIInd))/sqrt(size(HCcorr(:,ROIInd),1)),nanstd(LCcorr(:,ROIInd))/sqrt(size(LCco
rr(:,ROIInd),1));nanstd(HCcorr2(:,ROIInd))/sqrt(size(HCcorr2(:,ROIInd),1)),nanstd(LCcorr2(:,ROIIn
d))/sqrt(size(LCcorr2(:,ROIInd),1))];
figure(ROIInd)
hold on
T = strcat('CR-Hit correlation - ',ROINameSet(ROIInd));
if ROINameSet(ROIInd) == "MFG"
    T = "FA-Hit correlation - dIPFC";
end
title(T)
ngroups = size(Y, 1);
nbars = size(Y, 2);
groupwidth = min(0.8, nbars/(nbars + 1.5));
for i = 1:nbars
    x = (1:ngroups) - groupwidth/2 + (2*i-1) * groupwidth / (2*nbars);
    k(:,i) = x;
    if i == 1
        x1 = bar(x,Y(:,i),0.2,'FaceColor',[0 0.2 1])
    elseif i == 2
        x2 = bar(x,Y(:,i),0.2,'FaceColor',[1 0.2 0])
    elseif i == 3
        x3 = bar(x,Y(:,i),0.2,'FaceColor',[1 0.8 0.5])
    end
    errorbar(x, Y(:,i), Z(:,i), 'k.');
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end

if tresults2(1,ROIInd) == 1
    plot(k(1,1),max(Y(1,1)+Z(1,1),abs(Y(1,1))*0.2),'r*');
end
if tresults2(3,ROIInd) == 1
    plot(k(1,2),max(Y(1,2)+Z(1,2),abs(Y(1,2))*0.2),'r*');
end
if tresults2(5,ROIInd) == 1
    plot(k(2,1),max(Y(2,1)+Z(2,1),abs(Y(2,1))*0.2),'r*');
end
if tresults2(7,ROIInd) == 1
    plot(k(2,2),max(Y(2,2)+Z(2,2),abs(Y(2,2))*0.2),'r*');
end

MAX = max([Y(1,1)*1.1+Z(1,1),Y(1,2)*1.1+Z(1,2),Y(2,1)*1.1+Z(2,1),Y(2,2)*1.1+Z(2,2)]);
m = MAX * 0.1;
if tresults(1,ROIInd) == 1
    line([k(1,1),k(1,2)],[MAX,MAX],'Color','k')
    MAX = MAX+m;
end
if tresults(3,ROIInd) == 1
    line([k(2,1),k(2,2)],[MAX,MAX],'Color','k')
    MAX = MAX+m;
end
if tresults(5,ROIInd) == 1
    line([k(1,1),k(2,1)],[MAX,MAX],'Color','k')
    MAX = MAX+m;
end
if tresults(7,ROIInd) == 1
    line([k(1,2),k(2,2)],[MAX,MAX],'Color','k')
    MAX = MAX+m;
end

legend([x1 x2],{'high confidence trial','low confidence trial'})
xticks([1:2])
xticklabels({"Within-Category","Between-Category"})
hold off
end

for ROIInd = 1:length(ROINameSet)

    if tresults(1,ROIInd) == 1
        ROINameSet(ROIInd)
    end
end

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    end  
end  
fclose('all');
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