Must Read information before Running the Script

Written by Jinhong Luo, at CCNU, updated on May, 22, 2020. 1. This script will only run after you set the 'Regional format' of your computer (within the Time & Language setting) to Chinese (Simplified, China) and Restart the Matlab software. 2. Modify the paths for the data files (Use the Original Chinese version, not the Translated English version) based on where you put them. 3. If you get an warning or error message, check whether it is due to a missing function that is often associated with the version of the MATLAB. This script is written in Version 2018b. Otherwise, feel free to contact me: jluo@mail.ccnu.edu.cn

Contents

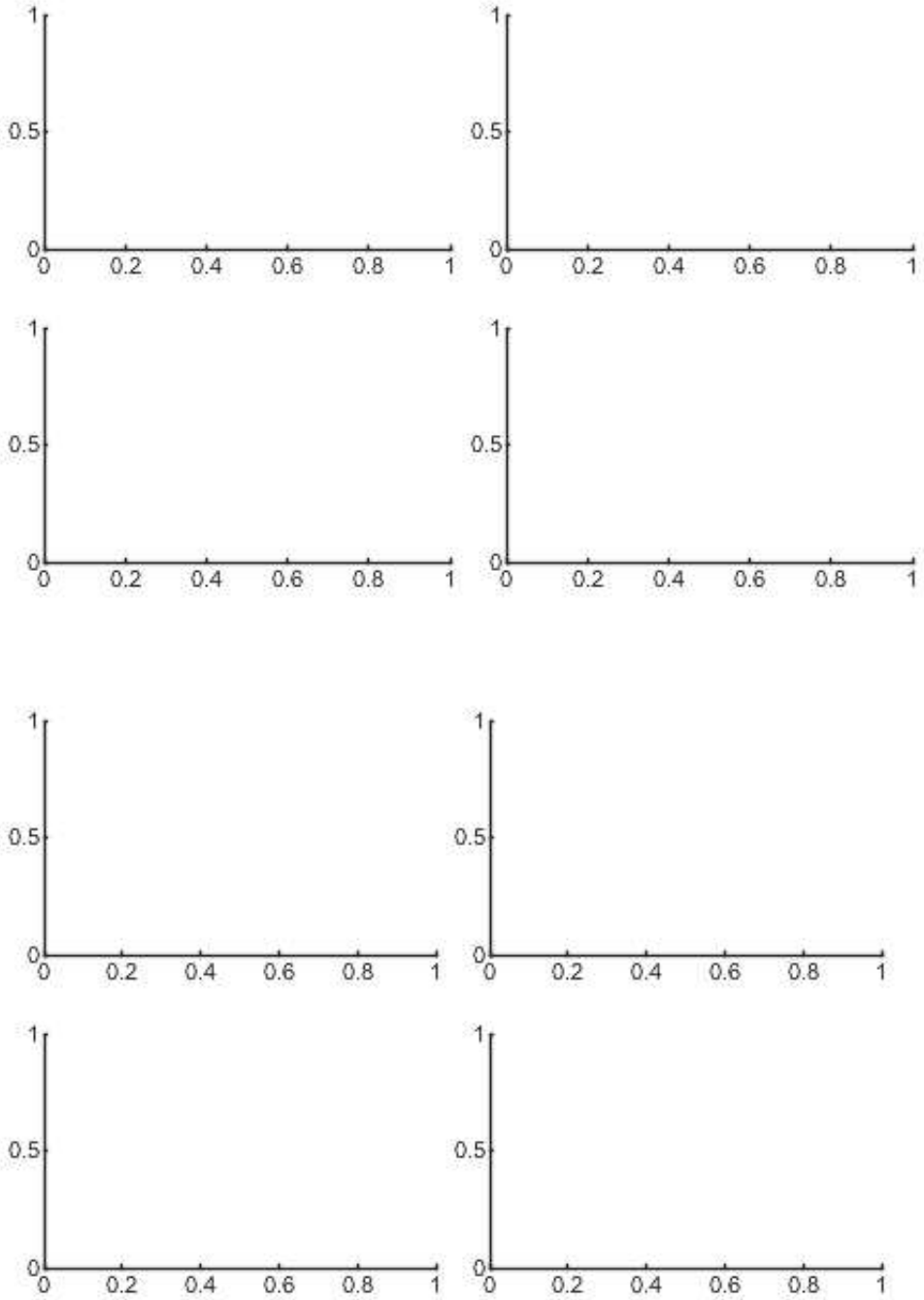
Preparations

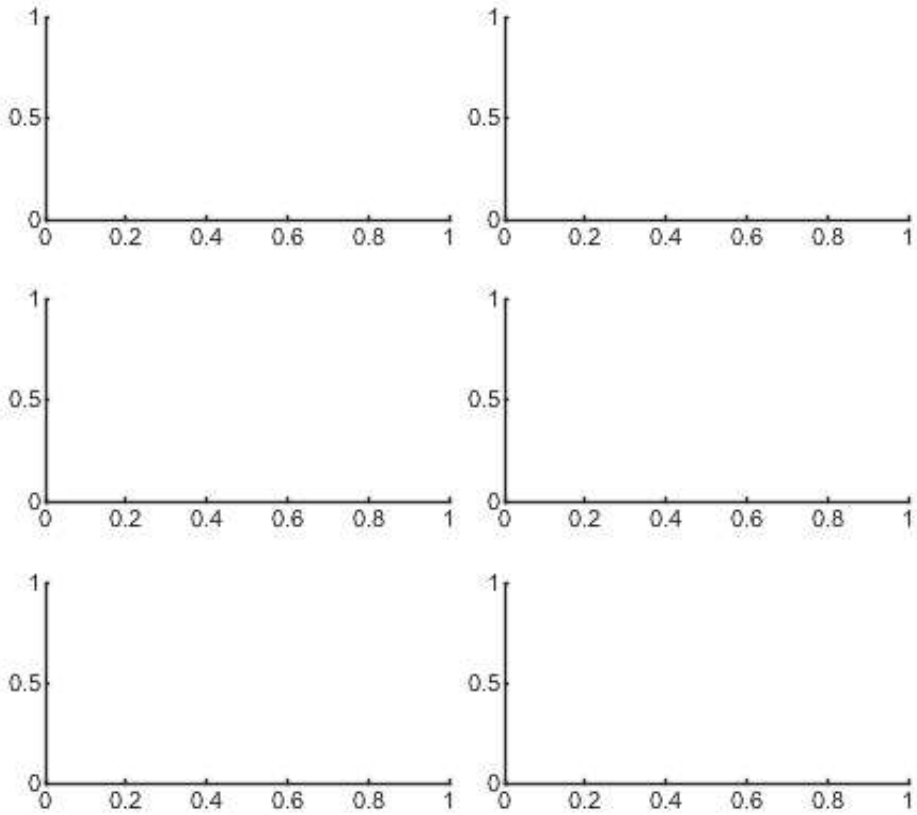
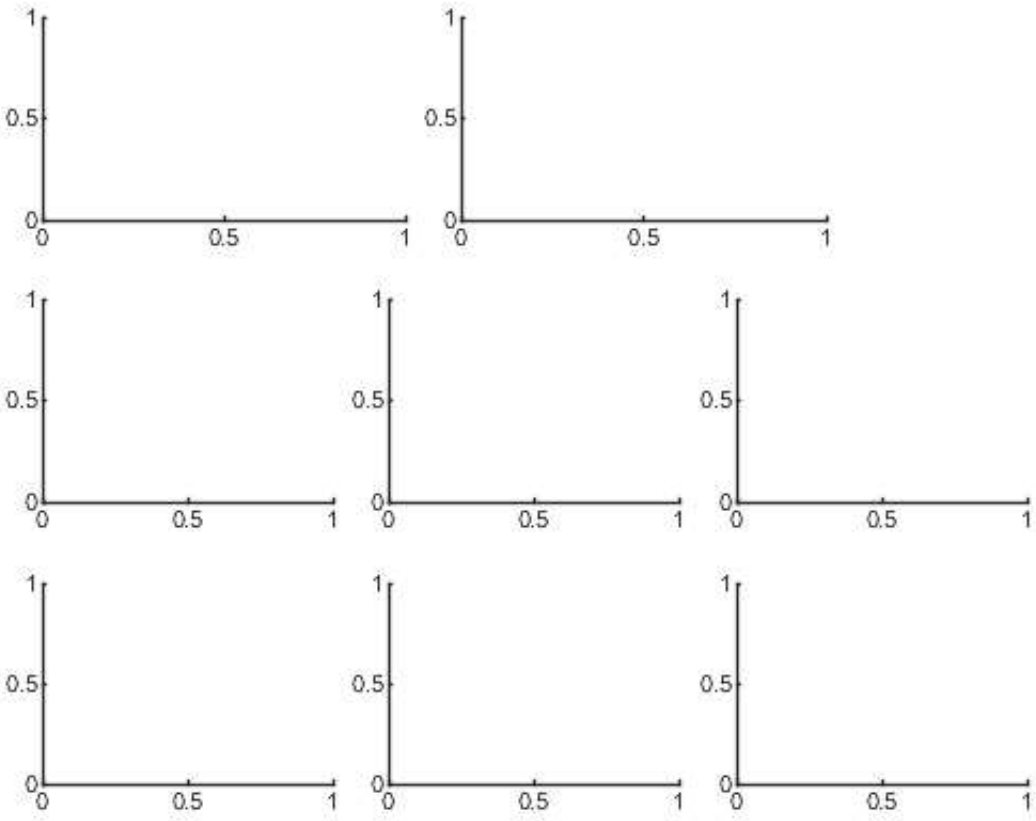
General

```
clear
close all

Result = struct; % the variable name to store the results

path = 'D:\Work\Paper\Professor\Jinhong\2020\Covid19\data\Original\'; % modify accordingly
pathfig = 'D:\Work\Paper\Professor\Jinhong\2020\Covid19\Submission\BiologicalConservation\
R1\figures\'; % modify accordingly

if isfile([path,'data_survey1.mat'])
    load([path,'data_survey1.mat']);
else
    [num_s1,txt_s1] = xlsread([path,'data_survey1.xlsx']);
    save([path,'data_survey1.mat'],'num_s1','txt_s1')
end

% the figures
FN = 'Arial';
FS = 8;
% figure 2: attitude towards bats and misconceptions of the bat-virus relationship
fig2 = figure;
ppos=[1 1 15 8.4]; % set the positon of the figure in a print page
pos=[25 5 15 8.4]; % set the position of the figure window and its size
set(gcf,'Units','Centimeters','PaperUnits','Centimeters',...
    'PaperPosition',ppos,'Position',pos,'Renderer','painters',...
    'Color',[1 1 1],'InvertHardCopy','off');

axw = 5.2;
axheight = 3;
horigap = 0.7;
vertgap = 1;
leftmarg = 1;
```

```
btmmarg = 1;
axh = zeros(2,2);
for i=1:size(axh,1)
    for j = 1:size(axh,2)
        axh(i,j)=axes;
        vpos = btmmarg+(vertgap+axheight)*(i-1);
        hpos = leftmarg+(horigap+axw)*(j-1);
        set(axh(i,j),'Units','Centimeters','FontName',FN,'FontSize',FS,'LineWidth',1,...
            'Position',[hpos,vpos,axw,axheight]);
    end
end

axh_fig2 = axh;

% figure 3: factors affecting the attitude to bat-virus relationship and to human actions
fig3 = figure;
ppos=[1 1 14 8.4]; % set the positon of the figure in a print page
pos=[25 5 14 8.4]; % set the position of the figure window and its size
set(gcf,'Units','Centimeters','PaperUnits','Centimeters',...
    'PaperPosition',ppos,'Position',pos,'Renderer','painters',...
    'Color',[1 1 1],'InvertHardCopy','off');

axw = 5;
axheight = 3;
horigap = 0.7;
vertgap = 1;
leftmarg = 1;
btmmarg = 1;
axh = zeros(2,2);
for i=1:size(axh,1)
    for j = 1:size(axh,2)
        axh(i,j)=axes;
        if i <= 2
            vpos = btmmarg+(vertgap+axheight)*(i-1);
        else
            vpos = btmmarg+(vertgap+axheight)*(i-1) + 0.4;
        end
        hpos = leftmarg+(horigap+axw)*(j-1);
        set(axh(i,j),'Units','Centimeters','FontName',FN,'FontSize',FS,'LineWidth',1,...
            'Position',[hpos,vpos,axw,axheight]);
    end
end

axh_fig3 = axh;

% figure 4: factors affecting the attitudes towards bats
fig4 = figure;
ppos=[1 1 15 11]; % set the positon of the figure in a print page
pos=[25 5 15 11]; % set the position of the figure window and its size
set(gcf,'Units','Centimeters','PaperUnits','Centimeters',...
    'PaperPosition',ppos,'Position',pos,'Renderer','painters',...
    'Color',[1 1 1],'InvertHardCopy','off');

axw = 5;
axheight = 2.5;
horigap = 0.7;
vertgap = 1;
leftmarg = 1;
btmmarg = 1;
axh = zeros(3,2);
for i=1:size(axh,1)
```

```
    for j = 1:size(axh,2)
        axh(i,j)=axes;
        vpos = btmmarg+(vertgap+axheight)*(i-1);
        hpos = leftmarg+(horigap+axw)*(j-1);
        set(axh(i,j),'Units','Centimeters','FontName',FN,'FontSize',FS,'LineWidth',1,...
            'Position',[hpos,vpos,axw,axheight]);
    end
end

axh_fig4 = axh;

% figure 5: conservation measures
fig5 = figure;
ppos=[1 1 14 10.9]; % set the positon of the figure in a print page
pos=[25 5 14 10.9]; % set the position of the figure window and its size
set(gcf,'Units','Centimeters','PaperUnits','Centimeters',...
    'PaperPosition',ppos,'Position',pos,'Renderer','painters',...
    'Color',[1 1 1],'InvertHardCopy','off');

axw = 3.6;
axheight = 2.5;
horigap = 0.7;
vertgap = 1;
leftmarg = 1.4;
btmmarg = 1;
axh = zeros(2,3);
for i=1:size(axh,1)
    for j = 1:size(axh,2)
        axh(i,j)=axes;
        vpos = btmmarg+(vertgap+axheight)*(i-1);
        hpos = leftmarg+(horigap+axw)*(j-1);
        set(axh(i,j),'Units','Centimeters','FontName',FN,'FontSize',FS,'LineWidth',1,...
            'Position',[hpos,vpos,axw,axheight]);
    end
end

axh_fig5 = axh;

axw = 4.5;
axheight = 2.5;
horigap = 0.7;
vertgap = 1;
leftmarg = 1.4;
btmmarg = btmmarg+(vertgap+axheight)*i;
axh = zeros(1,2);
for i=1:size(axh,1)
    for j = 1:size(axh,2)
        axh(i,j)=axes;
        vpos = btmmarg+(vertgap+axheight)*(i-1);
        hpos = leftmarg+(horigap+axw)*(j-1);
        set(axh(i,j),'Units','Centimeters','FontName',FN,'FontSize',FS,'LineWidth',1,...
            'Position',[hpos,vpos,axw,axheight]);
    end
end

axh_fig5a = axh;
```


1
0.5
0
0
0.2
0.4
0.6
0.8
1

Data Cleaning

```
txt_s1_title = txt_s1(1,:); % title row of survey 2
txt = txt_s1(2:end,:); % delete the title row to match the num
num = num_s1;
% ----- step 1:  dealing with impossible age
```

```
num(:,5) = str2double(txt(:,68)); % age in years

indxrm = (num(:,5)<12) | (num(:,5)>80) | isnan(num(:,5)); % age range
txt(indxrm,:) = [];
num(indxrm,:) = [];

% ----- step 2: check the age and education level mismatch
agerg = [12;14;17;20]; % the min age for secondary, high-school, undergraduate and graduat
e students
id = 71; % education level
dat = txt(:,id);
C = unique(dat);
indxrm = [];
for i = 1:length(C)
    str = C{i};
    indx = find(contains(dat,str));
    ages = num(indx,5);
    indx1 = find(ages<agerg(i));
    indxrm = [indxrm;indx(indx1)];
end

%txtrm = txt(indxrm,:);
txt(indxrm,:) = [];
num(indxrm,:) = [];

% ----- step 3: check the age, education level mismatch for students
agerg = [12,17;14,20;17,25;20,35]; % the age range for secondary, high-school, undergradua
te and graduate students
id = 72; % occupation
dat = txt(:,id);
C = unique(dat);

id = 71; % education level
datedu = txt(:,id);
Cedu = unique(datedu);

i = 1; % current students
str = C{i};
indx0 = find(contains(dat,str));

indxrm = [];
for j = 1:length(Cedu)
    str = Cedu{j};
    indx1 = find(contains(datedu,str));

    indx = intersect(indx0,indx1);

    ages = num(indx,5);

    indxt = find(ages<agerg(j,1)| ages>agerg(j,2));
    indxrm = [indxrm;indx(indxt)];
end

%txtrm = txt(indxrm,:);
txt(indxrm,:) = [];
num(indxrm,:) = [];

% ----- step 4: exclude the test time is shorter than half of the median
ttsmd = median(num(:,4)); % test time in seconds

ttsthrs = [ttsmd/4;ttsmd*4]; % response time limit
```

```
indxrm = find(num(:,4) < ttsthrs(1) | num(:,4) > ttsthrs(2));
txt(indxrm,:) = [];
num(indxrm,:) = [];

age = sortrows(num(:,5));

ttsmds1 = median(num(:,4)); % median test time for survey 1

num_s1_a = num;
txt_s1_a = txt;
N = length(txt);
```

Counting the respones

Multi-choice questions

```
idall = {9:15,22:32,52:56,58:62};
Qs = [1,6,23,24];
for qid = 1:length(idall)
    ids = idall{qid};
    counts = nan(length(ids),2);
    k = 1;
    for id = ids
        dat = txt(:,id);
        indx = find(~cellfun(@isempty,dat));
        counts(k,1) = length(indx);
        k = k + 1;
    end
    counts(:,2) = counts(:,1)/N*100;
    countsall.(['Q',num2str(Qs(qid))]) = counts;
end

% Single-choice questions
idall = [17:20,34:42,44:45,47:51,65:67,69,71:72];
Qs = [2:5,7:15,16:17,18:22,25:27,29,30:31];
for qid = 1:length(idall)
    id = idall(qid);
    dat = txt(:,id);
    C = unique(dat);
    counts = nan(length(C),2);
    k = 1;
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        counts(k,1) = length(indx);
        k = k + 1;
    end
    counts(:,2) = counts(:,1)/N*100;
    countsall.(['Q',num2str(Qs(qid))]) = counts;
end

% Descriptive stats of the data
tstr = {'knowledge_of_bats', 'bat_researcher', 'wildlife_researcher', 'attitude_bats_befor
e', 'atitude_bats_after',...
    'bats_only_source', 'carrier', 'carrier100', 'transmitter', 'attack_humans', 'outdoor_
bats',...
    'response_outdoor_bats', 'bat_eating','scientific_culling', 'ecological_culling', 'bat
_conservation',...
```

```
    'gender','education_level', 'current_occupation'};
ids = [17:19,34:42,47:49,65,67,71,72];
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;
end

datrt = array2table(datr,'VariableNames',tstr);
Result.Describe.Ns1 = size(datrt,1); % total participants of survey 1
Result.Describe.Ns1hedu = sum(datrt.(tstr{18})<=2); % undergraduate and graduate students
Result.Describe.Ns1female = sum(datrt.(tstr{17})==1); % female
Result.Describe.Ns1lknow = sum(datrt.(tstr{1})<=3); % lack a knowledge of bats
Result.Describe.Ns1outbat = sum(datrt.(tstr{11})<=2); % bats don't occur outdoor
Result.Describe.Ns1chasebat = sum(datrt.(tstr{12})==3); % chase bats
Result.Describe.Ns1moveaway = sum(datrt.(tstr{12})==4); % move away
Result.Describe.Ns1attack = sum(datrt.(tstr{10})>=4); % bats attack humans
Result.Describe.Ns1bateatd = sum(datrt.(tstr{13})<=2); % oppose to bat eating
Result.Describe.Ns1bateatn = sum(datrt.(tstr{13})==3); % neutral to bat eating
Result.Describe.Ns1sculld = sum(datrt.(tstr{14})<=2); % oppose to scientific culling
Result.Describe.Ns1sculla = sum(datrt.(tstr{14})>=4); % oppose to scientific culling
Result.Describe.Ns1eculld = sum(datrt.(tstr{15})<=2); % oppose to ecological culling
Result.Describe.Ns1eculla = sum(datrt.(tstr{15})>=4); % oppose to ecological culling
Result.Describe.Ns1prota = sum(datrt.(tstr{16})>=4); % support bat protection

fldnm = fieldnames(Result.Describe);
for i = 1:length(fldnm)
    Result.Describe.(fldnm{i})(2) = Result.Describe.(fldnm{i})(1)./Result.Describe.Ns1(1);
end

Nknowlowp = Result.Describe.Ns1lknow/Result.Describe.Ns1; % proportion of lack a knowledge
 of bats
Nhedup = Result.Describe.Ns1hedu/Result.Describe.Ns1; % proportion of higher education
Nfmp = Result.Describe.Ns1female/Result.Describe.Ns1; % proportion of females
Noutbatp = Result.Describe.Ns1outbat/Result.Describe.Ns1; % proportion of bats don't occur
 outdoor
Nchasebatp = Result.Describe.Ns1chasebat/Result.Describe.Ns1; % proportion of chase outdoo
r bats
Nmoveawayp = Result.Describe.Ns1moveaway/Result.Describe.Ns1; % proportion of move away
Nattackp = Result.Describe.Ns1attack/Result.Describe.Ns1; % proportion of bats attack huma
ns

Result.Describe.Ns1attbefore = tabulate(datrt.(tstr{4})); % attitude to bats before pandem
ic
Result.Describe.Ns1attafter = tabulate(datrt.(tstr{5})); % attitude to bats after pandemic
Nattposbefore = sum(Result.Describe.Ns1attbefore(4:5,3)); % proportion of positive attitud
e to bats before pandemic
Nattnegbefore = sum(Result.Describe.Ns1attbefore(1:2,3)); % proportion of negative attitud
e to bats before pandemic
Nattneubefore = sum(Result.Describe.Ns1attbefore(3,3)); % proportion of neutral attitude t
```

```
o bats before pandemic

Nattneuafter = sum(Result.Describe.Ns1attafter(3,3)); % proportion of neutral attitude to
bats after pandemic
Nattposcafter = sum(Result.Describe.Ns1attafter(4,3)); % proportion of curious attitude to
 bats after pandemic
Nattposlafter = sum(Result.Describe.Ns1attafter(5,3)); % proportion of like attitude to ba
ts after pandemic
Nattnegafter = sum(Result.Describe.Ns1attafter(1:2,3)); % proportion of negative attitude
to bats before pandemic

Nattneudiff = Nattneuafter - Nattneubefore; % difference in neutral attitude
Nattnegdiff = Nattnegafter - Nattnegbefore; % difference in negative attitude
Nattposcdiff = Nattposcafter - sum(Result.Describe.Ns1attbefore(4,3)); % difference in cur
ious attitude
Nattposldiff = Nattposlafter - sum(Result.Describe.Ns1attbefore(5,3)); % difference in lik
e attitude

stat_Natt = nan(4,2);
Natt = nan(2,5);
Natt(:,1) = [sum(Result.Describe.Ns1attbefore(1,2));sum(Result.Describe.Ns1attafter(1,2))]
; % dislike att
Natt(:,2) = [sum(Result.Describe.Ns1attbefore(2,2));sum(Result.Describe.Ns1attafter(2,2))]
; % fear att
Natt(:,3) = [sum(Result.Describe.Ns1attbefore(3,2));sum(Result.Describe.Ns1attafter(3,2))]
; % neutral
Natt(:,4) = [sum(Result.Describe.Ns1attbefore(4,2));sum(Result.Describe.Ns1attafter(4,2))]
; % curious
Natt(:,5) = [sum(Result.Describe.Ns1attbefore(5,2));sum(Result.Describe.Ns1attafter(5,2))]
; % like
Natt(:,6) = [Result.Describe.Ns1(1);Result.Describe.Ns1(1)];
for i = 1:5
    X = Natt(:,i);
    N = Natt(:,6);
    [h,p,chi2stat] = prop_test(X , N, 'true');
    stat_Natt(i,:) = [p,chi2stat];
end

% ----- Effects of attitude on bat-virus relationship miscenception
% attitudes before and after COVID-19, bat as carrier for SARS-CoV-2, bat
% transmits SARS-CoV-2 directly to humans, every bat carries SARS-CoV-2,
% most likely animals carrying SARS-CoV-2: bats, civet, pangalion
ids = [34,35,37,39,38,22,23,24];
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;
end

% combine attitudes into positive, neutral, and negative groups
```

```
for i = 1:2
    datr(datr(:,i)==5,i) = 4;
    datr(datr(:,i)==1,i) = 2;
end

% before COVID-19 attitude
% proportion of misconception on bat-virus relationship
ppc = nan(3,6); % proportion counts
n = nan(3,1); % sample size
x0 = datr; % overall proportion
xx = 1; % 1 and 2 for before and after COVID-19 attitude respectively
for i = 1:3 % three attitude groups
    x = datr(datr(:,xx) == i+1,:); %
    n(i,1) = length(x);
    for j = 1:6
        if j <= 3
            y = x(:,j+2)>=4;
            y0 = x0(:,j+2)>=4;
        else
            y = x(:,j+2)==1;
            y0 = x0(:,j+2)==1;
        end
        ppc(i,j) = sum(y);
    end
end

ppc = [n,ppc];

pp = ppc./ppc(:,1); % proportions

% attitude to bats before and after C19 and bat eating, scientific and ecological culling
and bat protection
dataa = [datrt.(tstr{4}),datrt.(tstr{5}),datrt.(tstr{13}),datrt.(tstr{14}),datrt.(tstr{15}
),datrt.(tstr{16})];
c = 1;
for k = 1:2
    for kk = 3:6
        [C,ia,ic] = unique(dataa(:,[k,kk]),'rows');
        a_counts = accumarray(ic,1);
        counts = [C,a_counts];
        if kk == 6
            counts_att(:,c) = [sum(counts([1:2,6:7],3));sum(counts(11:12,3));sum(counts([1
6:17,21:22],3))];
        else
            counts_att(:,c) = [sum(counts([4:5,9:10],3));sum(counts(14:15,3));sum(counts([
19:20,24:25],3))];
        end
        c = c + 1;
    end
end
```

figure 2: knowledge and attitudes towards bats

```
datk = [datrt.(tstr{1}),datrt.(tstr{2}),datrt.(tstr{3})]; % knowledge of bats, bat researc
her, wildlife researcher

for i = 1:3
    Nc{i} = tabulate(datk(:,i));
end
```

```
Nkh(1,1)= sum(datk(:,1)>=4 & datk(:,2)==1 & datk(:,3)==1); % amateur high knowledge
Nkh(2,1)= sum(datk(:,1)>=4 & datk(:,2)==1 & datk(:,3)==2); % wildlife reseracher high know
ledge
Nkh(3,1)= sum(datk(:,1)>=4 & datk(:,2)==2); % bat reseracher high knowledge

Nkh(1,2)= sum(datk(:,2)==1 & datk(:,3)==1); % amateur all
Nkh(2,2)= sum(datk(:,2)==1 & datk(:,3)==2); % wildlife reseracher all
Nkh(3,2)= sum(datk(:,2)==2); % bat reseracher all

Nkh(:,3) = Nkh(:,1)./Nkh(:,2);

Nkhop = sum(Nc{1,1}(4:5,3));

stat_Nkh = nan(3,2);
k = 1;
for i = 1:2
    for j = i+1:3
        X = Nkh([i,j],1);
        N = Nkh([i,j],2);
        [h,p,chi2stat] = prop_test(X , N, 'true');
        stat_Nkh(k,:) = [p,chi2stat];
        k = k + 1;
    end
end

axes(axh_fig2(2,1))
hBar = bar(Nkh(:,3)*100,'LineWidth',1);
hBar.BarWidth = 0.5;
hBar.FaceColor = [0.4,0.4,0.4];
% hold on
% plot([0,4],[Nkhop,Nkhop],'--','color',[0.5,0.5,0.5],'LineWidth',1)

text(0.6,80,{'With knowledge','of bats'},'FontName',FN,'FontSize',FS,'Fontw','Bold')

set(gca,'xtick',1:3,'Xticklabel',{'Untrained','Wildlife worker','Bat worker'},...
    'LineWidth',1,'FontName',FN,'FontSize',FS)
xlabel('Experience with bats','FontName',FN,'FontSize',FS)

xlim([0.5,3.5])
ylim([0,100])

yl = ylabel('Proportion of participants (%)','FontName',FN,'FontSize',FS);
yl.Position = yl.Position + [0,-65,0];

x = get(gca,'xlim');
y = get(gca,'ylim');
text(x(1)+0.1,y(2)*1.05,'A','FontName',FN,'FontSize',FS+2,'Fontw','Bold')

box off

hold on
yval = 40;
plot([1,2],[yval,yval],'-k','LineWidth',1)
text(1.5,45,'***','FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')
yval = 90;
plot([2,3],[yval,yval],'-k','LineWidth',1)
text(2.5,95,'***','FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

axes(axh_fig2(2,2))
atts = [Result.Describe.Ns1attbefore(:,3),Result.Describe.Ns1attafter(:,3)];
atts([1,2],:) = atts([2,1],:);
```

```
hBar = bar(atts,'LineWidth',1);
hBar(1).FaceColor = [0.8,0.8,0.8];
hBar(2).FaceColor = [0.2,0.2,0.2];
[lg,lgobj] = legend({'',''});
lg.LineWidth = 1;
lg.Location = 'northeast';
lg.Position = lg.Position + [0.13,0,0.063,-0.004];
lg.Color = 'none';
lgobj(3).Children.XData = lgobj(3).Children.XData.*0.29+0.01;
lgobj(4).Children.XData = lgobj(4).Children.XData.*0.29+0.01;
lgobj(3).Children.YData = lgobj(3).Children.YData.*0.6+0.25;
lgobj(4).Children.YData = lgobj(4).Children.YData.*0.6+0.1;

xtls = {'Dislike','Fear','Neutral','Curious','Like'};
set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
xlabel('Attitude towards bats','FontName',FN,'FontSize',FS)
ylabel('','FontName',FN,'FontSize',FS)

ylim([0,60])

box off

text(6.1,47,{'Before outbreak','After outbreak'},'FontName',FN,'FontSize',FS)
text(5.5,61,'Time','FontName',FN,'FontSize',FS,'Fontw','b')

x = get(gca,'xlim');
y = get(gca,'ylim');
text(x(1)+0.15,y(2)*1.05,'B','FontName',FN,'FontSize',FS+2,'Fontw','Bold')

yvals = [20,43,53,18,10];
pstr = {'***','***','***','***','ns'};
for i = 1:5
    text(i,yvals(i),pstr{i},'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')
end

% ----- Effects of wildlife experience on miscenception
% wildlife amateur, wildlife researcher, bat researcher, bat transmits
% SARS-CoV-2 directly to humans, each bat carries SARS-CoV-2, most likely
% animals carrying SARS-CoV-2: bats, civet, pangolin
ids = [19,18,37,39,38,22,23,24];
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;
end

x = ones(length(datr),1)*2;
indx = find(datr(:,1)==2 | datr(:,2)==2); % wildlife processionals
x(indx) = 1; % id for wildlife processionals
datr = [x,datr];
```

```
datr(datr(:,2)==2 & datr(:,3)==2,2) = 1; % exclude bat researchers from the wildlife profe
ssionals

% proportion of misconception on bat-virus relationship
ppc = nan(4,6); % proportion counts
n = nan(4,1); % sample size
n(4) = length(datr);
x0 = datr; % overall proportion
for i = 1:3
    x = datr(datr(:,i) == 2,:);
    n(i,1) = length(x);
    for j = 1:6
        if j <= 3
            y = x(:,j+3)>=4;
            y0 = x0(:,j+3)>=4;
        else
            y = x(:,j+3)==1;
            y0 = x0(:,j+3)==1;
        end
        ppc(i,j) = sum(y);
        ppc(4,j) = sum(y0);
    end
end

ppc = [n,ppc];

pp = ppc./ppc(:,1); % proportions

PPbv = sum(ppc)/length(num_s1_a); % overall misconception of bat-virus relationship

statsprop = struct;
% chi-square test
for par = 2:7
    k = 1;
    for i = 1:2
        for j = i+1:3
            X = ppc([i,j],par);
            N = ppc([i,j],1);
            [~,p,chi2stat] = prop_test(X , N, 'true');
            statsprop.pval(k,par) = p;
            statsprop.chi(k,par) = chi2stat;
            statsprop.pval(k,1) = nan;
            statsprop.chi(k,1) = nan;

            k = k + 1;
        end
    end
end

yy = {2:4,5:7};
lbs.x1 = {'Carrier','Transmitter', '100% carrier'};
lbs.x2 = {'Bats','Civets', 'Pangolins'};
xlbs = {'Credited role of bats in COVID-19','Top rated SARS-CoV-2 carrier'};
for kk = 1:2
    %subplot(1,2,kk)
    axes(axh_fig2(1,kk))
    hBar = bar(pp(1:3,yy{kk})'*100,'Linewidth',1);

    %colors = hot(length(hBar)); % hsv colormap
    %colors = [15,32,67;122,207,221;213,164,88]/255;
    colors = [7,9,9;68,68,68;255,0,0]/255;
```

```
    for i = 1:length(hBar)
        hBar(i).FaceColor = colors(i,:);
        hBar(i).EdgeColor = 'k';
    end

    ylim([0,100])

    lgstrs = {'Untrained','Wildlife worker','Bat worker'};
    if kk == 2
        [lg,lgobj] = legend({'','',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0.136,0,0.055,-0.015];
        lg.Color = 'none';
        offs = linspace(0.26,0.045,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.01;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.66+off;
        end
        text(3.92,71,lgstrs,'FontName',FN,'FontSize',FS)
        text(3.54,100,'Bat experience','FontName',FN,'FontSize',FS,'Fontw','Bold')
    end

    set(gca,'xticklabel',lbs.(['x',num2str(kk)])...
        ,'FontName',FN,'FontSize',FS, 'Linewidth',1)
    xlabel(xlbs{kk},'FontName',FN,'FontSize',FS)

    box off

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'C','D'};
    text(x(1)+0.1,y(2)*1.05,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

    hold on
    xvals = [1,2,3];

    if kk == 1
        yvals = [92,60,24];
        strs = {'ns','***','ns'};
    else
        yvals = [100,78,78];
        strs = {'***','***','ns'};
    end

    dx = 0.22;
    for jj = 1:3
        if strcmp(strs{jj},'ns')
            dy = 8;
        else
            dy = 4;
        end
        plot([xvals(jj)-dx,xvals(jj)+dx],[yvals(jj),yvals(jj)],'-k','LineWidth',1)
        text(xvals(jj),yvals(jj)+dy,strs{jj},'FontName',FN,'FontSize',FS,'Fontw','Bold','H
oriz','Center')
    end

end
```

```
print(fig2,'-dtiff','-r300',[pathfig,'fig2_attitude'])
```

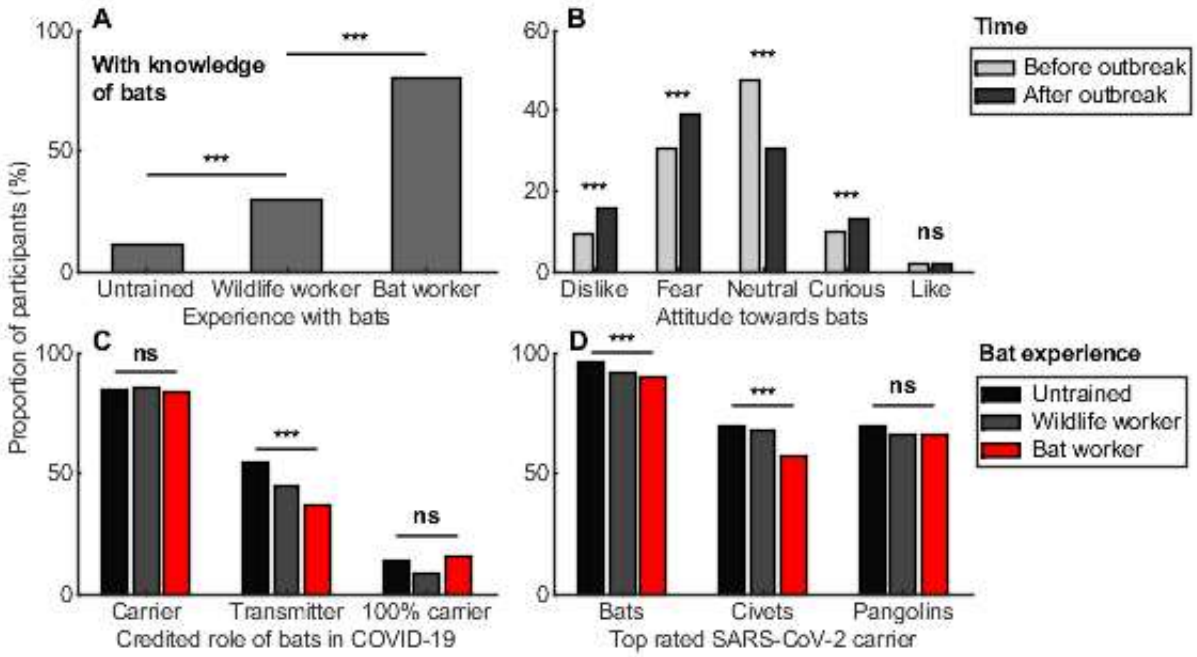


figure 3: attitudes towards human actions on bats

attitude before and after COVID-19, bat eating behavior, Scientific culling and ecological culling, conservation promotion,

```
ids = [34, 35, 47, 48, 49, 65]; % pre-attitude, post-attitude, eat bat, sci culling, ecolo
gical culling, bat protection
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;

end

% proportion of participants for human actions on bats
tbl = struct;
tbl.bateat = tabulate(datr(:,3)); % eat bat
tbl.scicull = tabulate(datr(:,4)); % sci cull
tbl.ecocull = tabulate(datr(:,5)); % sci cull
tbl.batprot = tabulate(datr(:,6)); % sci cull
pp_bateat_oppose = tbl.bateat(1,3) + tbl.bateat(2,3);
pp_scicull_oppose = tbl.scicull(1,3) + tbl.scicull(2,3);
pp_ecocull_oppose = tbl.ecocull(1,3) + tbl.ecocull(2,3);
pp_batprot_supp = tbl.batprot(4,3) + tbl.batprot(5,3);
```

```
% attitudes and bat eating behavior
for xx = 1:2 % 1 for before and 2 for after COVID-19
    [tbl,chi2,p,labels] = crosstab(datr(:,xx),datr(:,6));
    tbl0 = tabulate(datr(:,xx));

    tbl1 = sum(tbl(:,4:5),2);
    tblpp = tbl1./tbl0(:,2); % proportion of supports 1 means fear and 5 means like
    tbleat = [tbl0(:,2),tbl1,tblpp]; % counts by attitude group, counts supporting bat eat
ing, proportion

    statst = nan(4,2);
    for j = 1:4
        X = tbleat([j,5],2);
        N = tbleat([j,5],1);
        [h,p,chi2stat] = prop_test(X , N, 'true');
        statst(j,1) = p;
        statst(j,2) = chi2stat;
    end

    Result.bateat.(['att',num2str(xx)]){1} = tbleat; % counts
    Result.bateat.(['att',num2str(xx)]){2} = statst; % counts

end

% combine actions into positive, neutral, and negative groups
for i = 1:2
    datr(datr(:,i)==5,i) = 4;
    datr(datr(:,i)==1,i) = 2;
end

% combine attitudes into oppose, neutral, and support groups
for i = 3:6
    datr(datr(:,i)==5,i) = 4;
    datr(datr(:,i)==1,i) = 2;
end

Rstat = struct;
for xx = 2 % attitude id; 1 for before and 2 for after COVID-19 attitude
    for rid = 3:6
        [Rstat.(['B',num2str(rid)]),Rstat.(['dev',num2str(rid)]),Rstat.(['stats',num2str(r
id)])] ...
            = mnrfit(datr(:,xx),categorical(datr(:,rid)),'model','ordinal','interactions',
'off');
    end

    Result.s1.hmaction.(['stat',num2str(xx)]) = Rstat;

    %--------- before COVID-19 attitude  ---------
    ngroups = 3; % groups of the explanatory varibale
    xls = {'Bat bushmeat eating','Ecological Culling of bats','Scientific Culling of bats'
,'Bat protection promotion'};
    for kk = 1:4
        if kk <= 2
            if xx == 1 % attitude id; 1 for before and 2 for after COVID-19 attitude
                axes(axh_fig3(4,kk))
            else
                axes(axh_fig3(2,kk))
            end
        else
            if xx == 1
```

```
                axes(axh_fig3(3,kk-2))
            else
                axes(axh_fig3(1,kk-2))
            end
        end

        X = (3:5)';
        % before COVID-19
        [pihat,dlow,dhi] = mnrval(Rstat.(['B',num2str(kk+2)]),X,Rstat.(['stats',num2str(kk
+2)]),'Model','Ordinal');

        ctrs = 1:size(pihat,2);
        hBar = bar(ctrs, pihat'*100,'Linewidth',1);

        %colors = [7,9,9;68,68,68;255,0,0]/255;
        colors = [24,27,28;73,135,62;176,192,220]/255;
        for i = 1:length(hBar)
            hBar(i).FaceColor = colors(i,:);
            hBar(i).EdgeColor = 'k';
        end

        ctr = nan(length(hBar),length(ctrs));
        ydt = ctr;
        for k1 = 1:length(hBar)
            ctr(k1,:) = bsxfun(@plus, hBar(1).XData, [hBar(k1).XOffset]');
            ydt(k1,:) = hBar(k1).YData;
        end
        hold on
        ctr = ctr';
        ydt = ydt';
        for i = 1:size(ctr,1)
            err = errorbar(ctr(i,:), ydt(i,:), dlow(:,i)*100, dhi(:,i)*100,'linestyle','no
ne','color','k','linewidth',1);
        end

        ylim([0,100])

        lgstrs = {'Negative','Neutral','Positive'};
        if kk == 2
            [lg,lgobj] = legend({'','',''});
            %lg.Title.String = 'Gender';
            lg.LineWidth = 1;
            lg.Location = 'northeast';
            lg.Position = lg.Position + [0.14,-0.04,0.02,-0.015];
            lg.Color = 'none';
            offs = linspace(0.29,0.06,length(lgobj)/2);
            for i = length(lgobj)/2+1:length(lgobj)
                off = offs(i-length(lgobj)/2);
                lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.03;
                lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
            end
            text(3.85,60,lgstrs,'FontName',FN,'FontSize',FS)
            if xx == 1
                text(3.48,91,{'Attitude towards bats','before outbreak'},'FontName',FN,'Fo
ntSize',FS,'Fontw','Bold')
            else
                text(3.48,91,{'Attitude', 'towards bats'},'FontName',FN,'FontSize',FS,'Fon
tw','Bold')
            end
        end
```

```
        xtls = {'Disagree','Neutral','Agree'};
        set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
        xlabel(xls{kk},'FontName',FN,'FontSize',FS)

        if kk == 1
            yl2 = ylabel('Proportion of participants (%)','FontName',FN,'FontSize',FS);
            yl2.Position = yl2.Position + [0,-70,0];
        end

        box off

        x = get(gca,'xlim');
        y = get(gca,'ylim');
        if xx == 2
            %             lts = {'E','F','G','H'};
            %         else
            lts = {'A','B','C','D'};
        end
        text(x(1)+0.1,y(2)*1.05,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

        y0 = 80;
        dy = -15;
        t = Rstat.(['stats',num2str(kk+2)]).t(3); % t value for attitude
        p = Rstat.(['stats',num2str(kk+2)]).p(3); % p value for attitude
        if p < 0.001
            pstr = 'p < 0.001';
        elseif p < 0.01
            pstr = 'p < 0.01';
        elseif p < 0.05
            pstr = 'p < 0.05';
        else
            pstr = ['p = ', num2str(p,2)];
        end
        if kk ~= 4
            xpos = 3;
        else
            xpos = 1;
        end
        text(xpos,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Ho
riz','Center')
        text(xpos,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

    end
end

% h = annotation('line',[0.01,0.99],[0.505,0.505]);
% h.LineWidth = 1;
% h.Color = [0.5,0.5,0.5];


% % pre-pandemic attitude
% tvalabs = nan(4,3);
% pvals = tvalabs;
% for i = 3:6
%     tvalabs(i-2,:) = Result.s1.hmaction.stat1.(['stats',num2str(i)]).t;
%     pvals(i-2,:) = Result.s1.hmaction.stat1.(['stats',num2str(i)]).p;
% end
%
% tvalabs1 = tvalabs;
% pvals1 = pvals;
```

```
% post-pandemic attitude
tvalabs = nan(4,3);
pvals = tvalabs;
for i = 3:6
    tvalabs(i-2,:) = Result.s1.hmaction.stat2.(['stats',num2str(i)]).t;
    pvals(i-2,:) = Result.s1.hmaction.stat2.(['stats',num2str(i)]).p;
end

tvalabs2 = tvalabs;
pvals2 = pvals;

print(fig3,'-dtiff','-r300',[pathfig,'fig3_humanAction'])
```

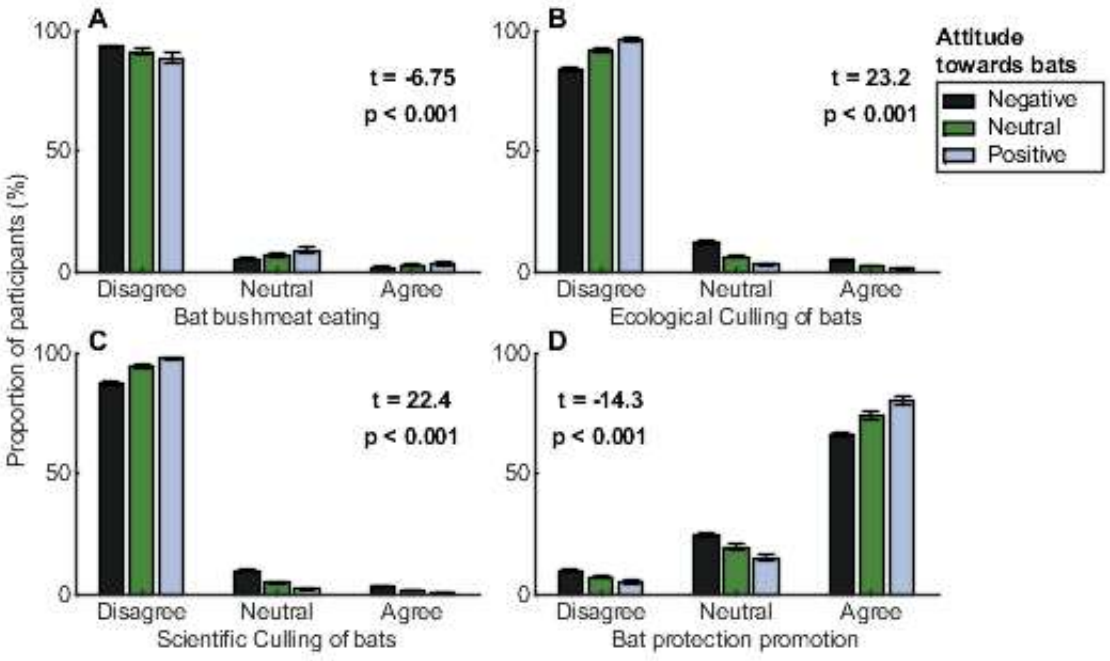


figure 4: factors affecting the attitudes towards bats

knowledge of bats, gender, age, education level, residential area, attitude before and after COVID-19, and after Questionnaire, wildlife researcher, bat researcher,

```
ids = [17, 67, 71, 34, 35, 66, 19, 18];
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;
end
datr = [datr(:,1:2),num(:,5),datr(:,3:end)]; % add age

place = zeros(length(txt),1);
```

```
x = contains(txt(:,69),'湖北省') & contains(txt(:,70),'武汉市');
y = contains(txt(:,69),'湖北省') & ~contains(txt(:,70),'武汉市');
place(x) = 2;
place(y) = 1;

datr = [datr(:,1:4),place,datr(:,5:end)];

% swap valus for dislike and fear group
for i = 6:8
    datr(datr(:,i)==1,i) = 10; % intermediate proxy
    datr(datr(:,i)==2,i) = 1;
    datr(datr(:,i)==10,i) = 2;
end

% combine attitudes into positive, neutral, and negative groups
for i = 6:8
    datr(datr(:,i)==5,i) = 4;
    datr(datr(:,i)==1,i) = 2;
end

% swap valus for education level
for i = 4
    datr(datr(:,i)==1,i) = 10; % intermediate proxy
    datr(datr(:,i)==4,i) = 1;
    datr(datr(:,i)==10,i) = 4;

    datr(datr(:,i)==2,i) = 9;
    datr(datr(:,i)==3,i) = 2;
    datr(datr(:,i)==9,i) = 3;
end

% sample size
Nnoknowposatt = size(datr(datr(:,1)==1 & datr(:,6)==4,:),1);

Xmd = round(nanmedian(datr(:,1:5))); % medians of the explanatory variables
%[b,dev,stats] = glmfit(datr(:,1:4),datr(:,5));
Rstat = struct;
for rid = 6:8 % attitude before and after COVID-19, and after Questionnaire,
    [Rstat.(['B',num2str(rid)]),Rstat.(['dev',num2str(rid)]),Rstat.(['stats',num2str(rid)]
)] ...
        = mnrfit(datr(:,1:5),categorical(datr(:,rid)),'model','ordinal','interactions','of
f');
end

Result.s1.att.stats = Rstat;

titlestr = {'Before outbreak','After outbreak'};
%--------- gender ---------
ngroups = 2; % groups of the explanatory varibale
for kk = 1:2
    %subplot(1,2,kk)
    axes(axh_fig4(3,kk))
    X = [repmat(Xmd(1),ngroups,1),(1:ngroups)',repmat(Xmd(3:end),ngroups,1)];
    % before COVID-19
    [pihat,dlow,dhi] = mnrval(Rstat.(['B',num2str(kk+5)]),X,Rstat.(['stats',num2str(kk+5)]
),'Model','Ordinal');

    ctrs = 1:size(pihat,2);
    hBar = bar(ctrs, pihat'*100,'Linewidth',1);
    hBar(1).FaceColor = 'r';
    hBar(2).FaceColor = 'k';
```

```
    ctr = nan(length(hBar),length(ctrs));
    ydt = ctr;
    for k1 = 1:length(hBar)
        ctr(k1,:) = bsxfun(@plus, hBar(1).XData, [hBar(k1).XOffset]');
        ydt(k1,:) = hBar(k1).YData;
    end
    hold on
    ctr = ctr';
    ydt = ydt';
    for i = 1:size(ctr,1)
        err = errorbar(ctr(i,:), ydt(i,:), dlow(:,i)*100, dhi(:,i)*100,'linestyle','none',
'color','k','linewidth',1);
    end

    ylim([0,80])

    lgstrs = {'Female','Male'};
    if kk == 2
        [lg,lgobj] = legend({'',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0.14,0,0.055,0];
        lg.Color = 'none';
        offs = linspace(0.27,0.1,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.01;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
        end
        text(3.96,61.8,lgstrs,'FontName',FN,'FontSize',FS)
        text(3.58,82,'Gender','FontName',FN,'FontSize',FS,'Fontw','Bold')
    end

    xtls = {'Negative','Neutral','Positive'};
    set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
    xlabel('Attitude towards bats','FontName',FN,'FontSize',FS)
    ylabel('','FontName',FN,'FontSize',FS)

    box off

    text(2,75,titlestr{kk},'FontName',FN,'FontSize',FS,'Fontw','Bold','HorizontalA','Cente
r')

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'A','B'};
    text(x(1)+0.1,y(2)*1.05,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

    y0 = 62;
    dy = -10;
    t = Rstat.(['stats',num2str(kk+5)]).t(4); % t value for gender
    p = Rstat.(['stats',num2str(kk+5)]).p(4); % p value for gender
    if p < 0.001
        pstr = 'p < 0.001';
    elseif p < 0.01
        pstr = 'p < 0.01';
    elseif p < 0.05
        pstr = 'p < 0.05';
    else
        pstr = ['p = ', num2str(p,2)];
```

```
    end
    text(3,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','C
enter')
    text(3,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')
end

%--------- knowledge level ---------
ngroups = 5; % groups of the explanatory varibale
for kk = 1:2
    %subplot(1,2,kk)
    axes(axh_fig4(2,kk))
    X = [(1:ngroups)',repmat(Xmd(2:end),ngroups,1)];
    % before COVID-19
    [pihat,dlow,dhi] = mnrval(Rstat.(['B',num2str(kk+5)]),X,Rstat.(['stats',num2str(kk+5)]
),'Model','Ordinal');

    ctrs = 1:size(pihat,2);
    hBar = bar(ctrs, pihat'*100,'Linewidth',1);
    ctr = nan(length(hBar),length(ctrs));
    ydt = ctr;
    for k1 = 1:length(hBar)
        ctr(k1,:) = bsxfun(@plus, hBar(1).XData, [hBar(k1).XOffset]');
        ydt(k1,:) = hBar(k1).YData;
    end
    hold on
    ctr = ctr';
    ydt = ydt';
    for i = 1:size(ctr,1)
        err = errorbar(ctr(i,:), ydt(i,:), dlow(:,i)*100, dhi(:,i)*100,'linestyle','none',
'color','k','linewidth',1);
    end

    ylim([0,80])

    lgstrs = {'No','Very little','Little','Some','Plenty'};
    if kk == 2
        [lg,lgobj] = legend({'','','','',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0.14,0,0.055,0];
        lg.Color = 'none';
        offs = linspace(0.32,0.05,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.01;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
        end
        text(3.96,44.2,lgstrs,'FontName',FN,'FontSize',FS)
        text(3.58,82,'Knowledge of bats','FontName',FN,'FontSize',FS,'Fontw','Bold')
    end

    if kk == 1
        yl2 = ylabel('Proportion of participants (%)','FontName',FN,'FontSize',FS);
    end
    yl2.Position = yl2.Position + [-0.04,0,0];
    yl2.FontSize = FS;

    xtls = {'Negative','Neutral','Positive'};
    set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
    xlabel('Attitude towards bats','FontName',FN,'FontSize',FS)
```

```
    box off

    text(2,75,titlestr{kk},'FontName',FN,'FontSize',FS,'Fontw','Bold','HorizontalA','Cente
r')

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'C','D'};
    text(x(1)+0.1,y(2)*1.05,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

    y0 = 62;
    dy = -10;
    t = Rstat.(['stats',num2str(kk+5)]).t(3); % t value for knowledge level
    p = Rstat.(['stats',num2str(kk+5)]).p(3); % p value for knowledge level
    if p < 0.001
        pstr = 'p < 0.001';
    elseif p < 0.01
        pstr = 'p < 0.01';
    elseif p < 0.05
        pstr = 'p < 0.05';
    else
        pstr = ['p = ', num2str(p,2)];
    end
    text(3,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','C
enter')
    text(3,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

end

%--------- education level ---------
ngroups = 4; % groups of the explanatory varibale
for kk = 1:2
    %subplot(1,2,kk)
    axes(axh_fig4(1,kk))
    X = [repmat(Xmd(1:3),ngroups,1),(1:ngroups)',repmat(Xmd(5:end),ngroups,1)];
    % before COVID-19
    [pihat,dlow,dhi] = mnrval(Rstat.(['B',num2str(kk+5)]),X,Rstat.(['stats',num2str(kk+5)]
),'Model','Ordinal');

    ctrs = 1:size(pihat,2);
    hBar = bar(ctrs, pihat'*100,'Linewidth',1);

    colors = prism(length(hBar)); % hsv colormap
    for i = 1:length(hBar)
        hBar(i).FaceColor = colors(i,:);
    end

    ctr = nan(length(hBar),length(ctrs));
    ydt = ctr;
    for k1 = 1:length(hBar)
        ctr(k1,:) = bsxfun(@plus, hBar(1).XData, [hBar(k1).XOffset]');
        ydt(k1,:) = hBar(k1).YData;
    end
    hold on
    ctr = ctr';
    ydt = ydt';
    for i = 1:size(ctr,1)
        err = errorbar(ctr(i,:), ydt(i,:), dlow(:,i)*100, dhi(:,i)*100,'linestyle','none',
'color','k','linewidth',1);
    end
```

```
    ylim([0,80])
    lgstrs = {'Middle school','High school','College','Graduate'};
    if kk == 2
        [lg,lgobj] = legend({'','','',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0.14,0,0.055,0];
        lg.Color = 'none';
        offs = linspace(0.32,0.05,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.01;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
        end
        text(3.96,49.5,lgstrs,'FontName',FN,'FontSize',FS)
        text(3.58,82,'Education level','FontName',FN,'FontSize',FS,'Fontw','Bold')
    end

    xtls = {'Negative','Neutral','Positive'};
    set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
    xlabel('Attitude towards bats','FontName',FN,'FontSize',FS)

    box off

    text(2,75,titlestr{kk},'FontName',FN,'FontSize',FS,'Fontw','Bold','HorizontalA','Cente
r')

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'E','F'};
    text(x(1)+0.1,y(2)*1.05,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

    y0 = 62;
    dy = -10;
    t = Rstat.(['stats',num2str(kk+5)]).t(6); % t value for education level
    p = Rstat.(['stats',num2str(kk+5)]).p(6); % p value for education level
    if p < 0.001
        pstr = 'p < 0.001';
    elseif p < 0.01
        pstr = 'p < 0.01';
    elseif p < 0.05
        pstr = 'p < 0.05';
    else
        pstr = ['p = ', num2str(p,2)];
    end
    text(3,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','C
enter')
    text(3,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

end

print(fig4,'-dtiff','-r300',[pathfig,'fig4_attitudeDifference'])
```

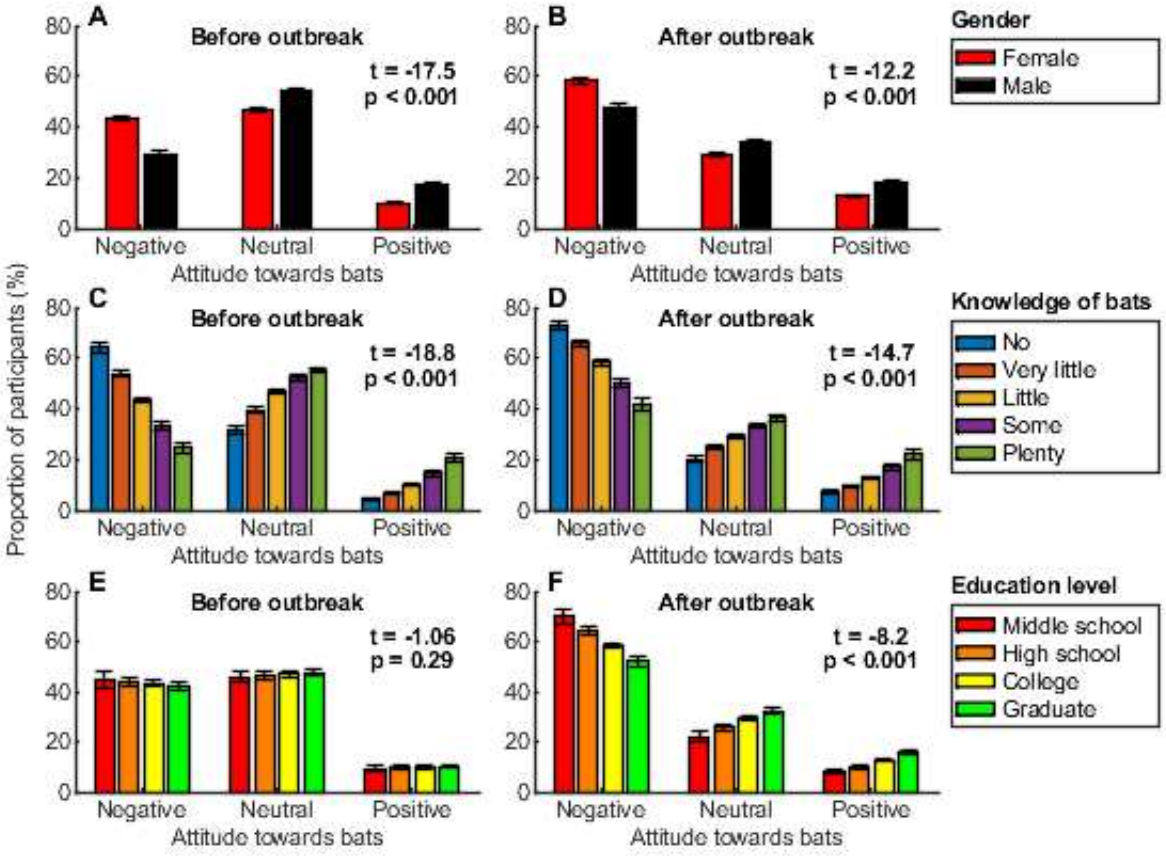


figure 5: Conservation measures

ecological culling before and after message, attitudes before and after COVID-19, and after questionnaire

```
ids = [49,50,34,35,66];
datr = nan(length(txt),length(ids));
kk = 1;
for id = ids
    dat = txt(:,id);
    C = unique(dat);

    k = length(C);
    for i = 1:length(C)
        str = C{i};
        indx = find(contains(dat,str));
        datr(indx,kk) = k;
        k = k - 1;
    end

    kk = kk +1;
end

% combine data into three category
for id = 1:length(ids)
    datr(datr(:,id)==5,id) = 4;
    datr(datr(:,id)==1,id) = 2;
end

pps = nan(3,5);
for i = 1:length(ids)
    tab = tabulate(datr(:,i));
    pps(:,i) = tab(2:4,3);
end
```

```
ide = [ones(length(datr),1);ones(length(datr),1)*2];
dats1 = [datr(:,1);datr(:,2)]; % ecological culling before and after the message
dats2 = [datr(:,3);datr(:,5)]; % attitude before COVID-19 and after questionnair
dats3 = [datr(:,4);datr(:,5)];  % attitude after COVID-19 and after questionnair

datr = [ide,dats1,dats2,dats3];

Rstat = struct;
for rid = 2:4
    [Rstat.(['B',num2str(rid)]),Rstat.(['dev',num2str(rid)]),Rstat.(['stats',num2str(rid)]
)] ...
        = mnrfit(datr(:,1),categorical(datr(:,rid)),'model','ordinal','interactions','off'
);
end

Result.s1.message.stats = Rstat;

ppsdiff = nan(3,3); % change in attitudes
ppsdiff(:,1) = pps(:,2)-pps(:,1);
ppsdiff(:,2) = pps(:,5)-pps(:,3);
ppsdiff(:,3) = pps(:,5)-pps(:,4);

xlbs = {'Ecological bat culling','Attitude towards bats after the outbreak'};
infos = {'Message 1','Message 2','Pre-pandemic','Post-pandemic'};
for kk = 1:2
    axes(axh_fig5a(1,kk))
    if kk == 2 % message 2 post pandemic attitude
        mm = kk + 2;
    else
        mm = kk;
    end
    hBar = bar([pps(:,mm),pps(:,mm+1)],'Linewidth',1);
%     hBar(1).BarWidth = 0.5;
%     hBar(2).BarWidth = 0.5;
    hBar(1).FaceColor = [0.8,0.8,0.8];
    hBar(2).FaceColor = [0.2,0.2,0.2];
    %     hold on
    %     hBar = bar(pps(:,kk+1)','Linewidth',1);
    %     hBar.BarWidth = 0.5;
    %     hBar.FaceColor = [0,0,1];

    xlim([0.4,3.6])

    %     ylim([-40,40])

    if kk == 1
        xtls = {'Disagree','Neutral','Agree'};
    else
        xtls = {'Negative','Neutral','Positive'};
    end


    %text(2,-30,infos{2,kk},'FontName',FN,'FontSize',FS,'Horiz','Center','FontW','bold')

    set(gca,'xtick',1:3,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)

    xlabel(xlbs{kk},'FontName',FN,'FontSize',FS)

    if kk == 1
        ylabel({'Proportion', 'of participants (%)'},'FontName',FN,'FontSize',FS)
```

```
    end

    box off

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'A','B','C'};
    text(x(1)+0.1,y(2)*1,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')

    if kk == 1
        y0 = 85;
        dy = -15;
        text(2,100,infos{1,kk},'FontName',FN,'FontSize',FS,'Horiz','Center','FontW','bold'
)
    else
        y0 = 50;
        dy = -8;
        text(2,60,infos{1,kk},'FontName',FN,'FontSize',FS,'Horiz','Center','FontW','bold')
    end



    if kk == 2
        m = 4;
    else
        m = 2;
    end
    t = Rstat.(['stats',num2str(m)]).t(3); % t value
    p = Rstat.(['stats',num2str(m)]).p(3); % p value
    if p < 0.001
        pstr = 'p < 0.001';
    elseif p < 0.01
        pstr = 'p < 0.01';
    elseif p < 0.05
        pstr = 'p < 0.05';
    else
        pstr = ['p = ', num2str(p,2)];
    end

    xpos = 3;

    text(xpos,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz'
,'Center')
    text(xpos,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

    if kk == 2
        lgstrs = {'Premessage','Postmessage'};
        [lg,lgobj] = legend({'',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0.15,0,0.044,0.01];
        lg.Color = 'none';
        offs = linspace(0.27,0.09,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.03;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
        end
        text(4.15,49,lgstrs,'FontName',FN,'FontSize',FS)
        %text(3.54,104,'Attitude to bats','FontName',FN,'FontSize',FS,'Fontw','Bold')
```

```
    end

end

% Survey 2: only analyze data for current students: from undergraduates to postdoc
% pre-course
dfilenm = 'data_survey2_01';
if isfile([path,dfilenm,'.mat'])
    load([path,dfilenm,'.mat']);
else
    [num_s2_p1,txt_s2_p1] = xlsread([path,dfilenm,'.xlsx']);
    save([path,dfilenm,'.mat'],'num_s2_p1','txt_s2_p1')
end

% post-course
dfilenm = 'data_survey2_02';
if isfile([path,dfilenm,'.mat'])
    load([path,dfilenm,'.mat']);
else
    [num_s2_p2,txt_s2_p2] = xlsread([path,dfilenm,'.xlsx']);
    save([path,dfilenm,'.mat'],'num_s2_p2','txt_s2_p2')
end

% clean the data
numttl = 3137+15735; % total number of registered student course participants
txt_s2_title = txt_s2_p1(1,:); % title row of survey 2
txt_s2p1 = txt_s2_p1(2:end,:);% delete the title row to mach the num
num_s2p1 = num_s2_p1;
txt_s2p2 = txt_s2_p2(2:end,:);% delete the title row to mach the num
num_s2p2 = num_s2_p2;

%-------- pre-lecture data -----------------------------
% ----- Step 1: test time limitation
% set the end time of 13:30 when the course began for precourse test
indx = 614;
txt_s2p1(1:indx,:) = [];
num_s2p1(1:indx,:) = [];

% ----- step 2: check the age, education level mismatch for students
% precourse test
num = num_s2p1;
txt = txt_s2p1;
agerg = [12,17;14,20;17,25;20,32]; % the age range for secondary, high-school, undergradua
te and graduate students
id = 12; % occupation
dat = txt(:,id);
C = unique(dat);

id = 11; % education level
datedu = txt(:,id);
Cedu = unique(datedu);

i = 1; % current students
str = C{i};
indx0 = find(contains(dat,str));

a1 = length(indx0); % counts before applying data exclusion criteria

x1 = length(indx0);
y1 = length(dat);
```

```
indxrm = [];
for j = 1:length(Cedu)
    str = Cedu{j};
    indx1 = find(contains(datedu,str));

    indx = intersect(indx0,indx1);

    ages = num(indx,10);

    indxt = find(ages<agerg(j,1)| ages>agerg(j,2));
    indxrm = [indxrm;indx(indxt)];
end

%txtrm = txt(indxrm,:);
txt(indxrm,:) = [];
num(indxrm,:) = [];

% ----- step 3: exclude the test time is shorter than half of the median
tts = num(:,4); % test time in seconds
ttssort = sortrows(tts,1);

ttsmd = median(tts);

ttsthrs = [ttsmd/4;ttsmd*4]; % response time limit

indxrm = find(num(:,4) < ttsthrs(1) | num(:,4) > ttsthrs(2));
txt(indxrm,:) = [];
num(indxrm,:) = [];

num_s2p1 = num;
txt_s2p1 = txt;

% ----- Step 4: age range limit: 17 - 32 for graduate to postgraduate
indxrm = (num_s2p1(:,10)<17) | (num_s2p1(:,10)>35); % age range
txt_s2p1(indxrm,:) = [];
num_s2p1(indxrm,:) = [];

%-------- post-lecture data -----------------------------
% ----- Step 1: test time limitation
% set the end time of 20:00 for postcourse test
indx = 65;
txt_s2p2(1:indx,:) = [];
num_s2p2(1:indx,:) = [];

% ----- step 2: check the age, education level mismatch for students
% postcourse test
num = num_s2p2;
txt = txt_s2p2;
agerg = [12,17;14,20;17,25;20,32]; % the age range for secondary, high-school, undergradua
te and graduate students
id = 12; % occupation
dat = txt(:,id);
C = unique(dat);

id = 11; % education level
datedu = txt(:,id);
Cedu = unique(datedu);

i = 1; % current students
str = C{i};
indx0 = find(contains(dat,str));
```

```
a2 = length(indx0); % counts before applying data exclusion criteria

x2 = length(indx0);
y2 = length(dat);

ppstu = (x1+x2)/(y1+y2);

indxrm = [];
for j = 1:length(Cedu)
    str = Cedu{j};
    indx1 = find(contains(datedu,str));

    indx = intersect(indx0,indx1);

    ages = num(indx,10);

    indxt = find(ages<agerg(j,1)| ages>agerg(j,2));
    indxrm = [indxrm;indx(indxt)];
end

%txtrm = txt(indxrm,:);
txt(indxrm,:) = [];
num(indxrm,:) = [];

% ----- step 4: exclude the test time is shorter than half of the median
tts = num(:,4); % test time in seconds
ttssort = sortrows(tts,1);

ttsmd = median(tts);

ttsthrs = [ttsmd/4;ttsmd*4]; % response time limit

indxrm = find(num(:,4) < ttsthrs(1) | num(:,4) > ttsthrs(2));
txt(indxrm,:) = [];
num(indxrm,:) = [];

num_s2p2 = num;
txt_s2p2 = txt;

% ----- Step 4: age range limit: 17 - 32 for graduate to postgraduate
indxrm = (num_s2p2(:,10)<17) | (num_s2p2(:,10)>35); % age range
txt_s2p2(indxrm,:) = [];
num_s2p2(indxrm,:) = [];

age1 = sortrows(num_s2p1(:,10));
age2 = sortrows(num_s2p2(:,10));

tts1 = sortrows(num_s2p1(:,4));
tts2 = sortrows(num_s2p2(:,4));

ttsmds2 = median([tts1;tts2]); % median test time for survey 2

% percentage of the valide data points to the total course participants
numdatapp = (length(num_s2p1)+length(num_s2p2))/numttl;

parrates2 = (length(txt_s2p1) + length(txt_s2p2))/(15735+3137); % participating rate of qu
estionnaire 1

a11 = length(txt_s2p1);
a21 = length(txt_s2p2);
```

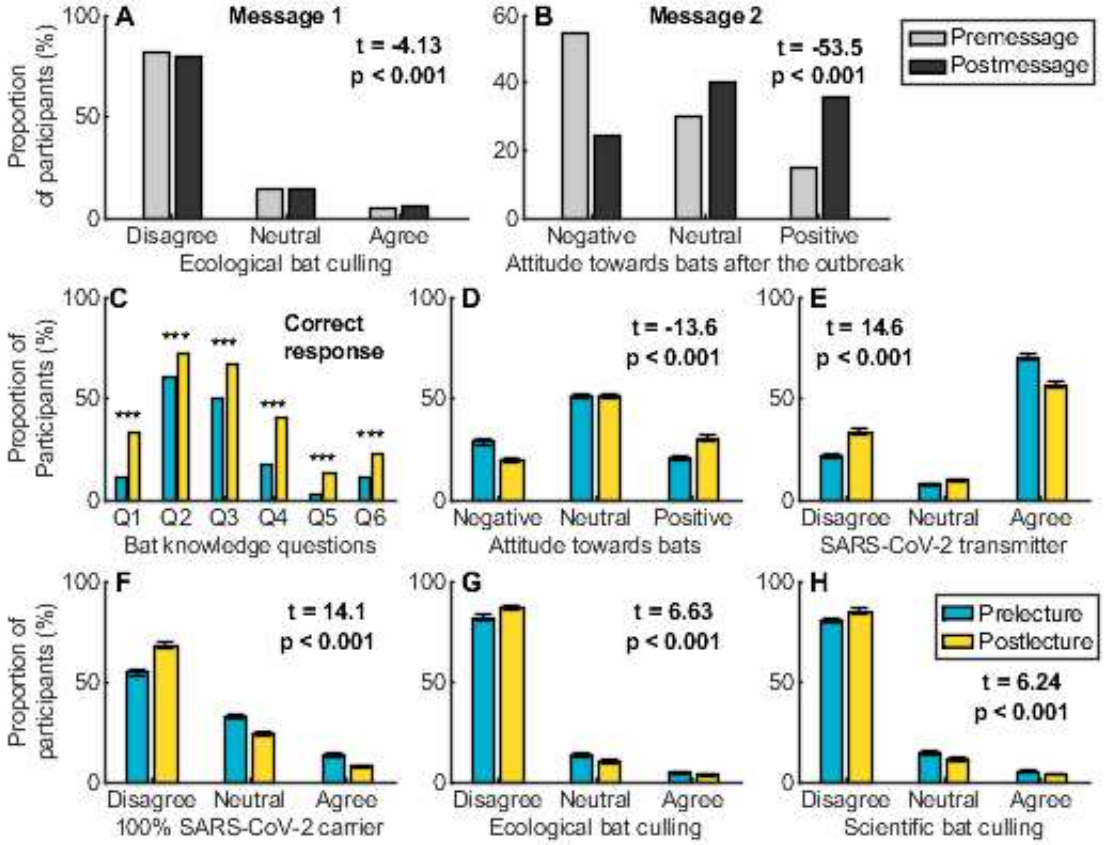
```
ppexc = ((a1+a2) - (a11+a21))/(a1+a2);

% Effects of lecture on the Knowledge of bats
% knowledge of bats, bat attacks humans intentionally and 4 bat fact questions, and
ids = [15,34,16,17,18:25];
pars = 6;
corrcounts = nan(2,pars); % proportion of positively indicated knowledge and correct answe
rs to bat fact questions
% corrcounts(1,1) = length(txt_s2p1); % total participants for precourse
% corrcounts(2,1) = length(txt_s2p2); % total participants for postcourse

for testid = 1:2
    if testid == 1
        txt = txt_s2p1(:,ids); % precourse test
    else
        txt = txt_s2p2(:,ids); % precourse test
    end
    datr = nan(size(txt,1),pars);
    for id = 1:pars % five questions in total
        if id <= 4
            dat = txt(:,id);
            C = unique(dat);
            k = length(C);
            for i = 1:length(C)
                str = C{i};
                indx = find(contains(dat,str));
                datr(indx,id) = k;
                k = k - 1;
            end
        elseif id == 5
            A = ~cellfun(@isempty,txt(:,5:8));
            B = (sum(A(:,1:3),2) == 3 & A(:,4) == 0);
            datr(:,id) = double(B)+1;

        elseif id == 6
            A = ~cellfun(@isempty,txt(:,9:12));
            B = (sum(A(:,2:4),2) == 3 & A(:,1) == 0);
            datr(:,id) = double(B)+1;

        end

    end

    % bat fact questions
    for i = 1:pars
        if i == 1
            idc  = 4;
            corrcounts(testid,i) = sum((datr(:,i) >= idc));
        elseif i == 2
            idc = 2;
            corrcounts(testid,i) = sum((datr(:,i) <= idc));
        elseif i <= 4
            idc = 1;
            corrcounts(testid,i) = sum((datr(:,i) == idc));
        else
            idc = 2;
            corrcounts(testid,i) = sum((datr(:,i) == idc));
        end
    end
end
```

```
N = [length(txt_s2p1);length(txt_s2p2)];
stats = nan(2,pars);
for i = 1:pars
    X = corrcounts(:,i);
    [~,p,chi2stat] = prop_test(X , N, 'true');
    stats(1,i) = p; % pval
    stats(2,i) = chi2stat; % chistat
end

Result.s2.know.stats = stats;

corrpp = corrcounts./N;
corrppinc = corrpp(2,:)-corrpp(1,:);

axes(axh_fig5(2,1))
hBar = bar(corrpp(:,1:end)'*100,'Linewidth',1);
hBar(1).FaceColor = [0 177 210]/255;
hBar(2).FaceColor = [253 219 39]/255;
% hBar(1).FaceColor = [24,27,28]/255;
% hBar(2).FaceColor = [73,135,62]/255;
% lg = legend({'Prelecture','Postlecture'},'FontName',FN,'FontSize',FS);
% lg.LineWidth = 1;
ylim([0,100])

xtls = {'Q1','Q2','Q3','Q4','Q5','Q6'};
set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
xlabel('Bat knowledge questions','FontName',FN,'FontSize',FS)
ylabel({'Proportion of', 'Participants (%)'},'FontName',FN,'FontSize',FS)

text(4.2,80,{'Correct', 'response'},'FontName',FN,'FontSize',FS,'Fontw','Bold')

box off

x = get(gca,'xlim');
y = get(gca,'ylim');
text(x(1)+0.1,y(2)*1,'C','FontName',FN,'FontSize',FS+2,'Fontw','Bold')

yvals = [40,78,75,45,18,30];
pstr = {'***','***','***','***','***','***'};
for i = 1:6
    text(i,yvals(i),pstr{i},'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')
end

% Effects of lecture on the attitudes towards bats
% gender, education level, test participation history, attitude to bats, virus transmitter
, 100%
% carrier, ecological culling, scientific culling
ids = [9,11,14,35,26,27,32,33];

datall = [];
for testid = 1:2
    if testid == 1
        txt = txt_s2p1(:,ids); % precourse test
    else
        txt = txt_s2p2(:,ids); % precourse test
    end

    datr = nan(length(txt),length(ids));
    kk = 1;
```

```
    for id = 1:length(ids)
        dat = txt(:,id);
        C = unique(dat);

        k = length(C);
        for i = 1:length(C)
            str = C{i};
            indx = find(contains(dat,str));
            datr(indx,kk) = k;
            k = k - 1;
        end
        kk = kk +1;
    end

    datall = [datall;datr];
end

Nnew = sum(datall(:,3) == 2); % new participants, excluding those who have participated in
 the 1st questionnair

testids = [ones(length(txt_s2p1),1);ones(length(txt_s2p2),1)*2]; % 1 for prelecture, 2 for
 postlecture

datr = [testids,datall]; % effect of bat lecture

% combine attitudes to bats, virus carrier, 100% carrier, ecological culling, scientific c
ulling into
% positive, neutral, and negative groups
for id = 5:9
    datr(datr(:,id)==5,id) = 4;
    datr(datr(:,id)==1,id) = 2;
end

Xmd = round(nanmedian(datr(:,1:4))); % medians of the explanatory variables
%[b,dev,stats] = glmfit(datr(:,1:4),datr(:,5));
Rstat = struct;
for rid = 5:9
    [Rstat.(['B',num2str(rid)]),Rstat.(['dev',num2str(rid)]),Rstat.(['stats',num2str(rid)]
)] ...
        = mnrfit(datr(:,1:4),categorical(datr(:,rid)),'model','ordinal','interactions','of
f');
end

Result.s2.hmaction.stats = Rstat;

titlestr = {'Pre-lecture','Post-lecture'};
xlbs = {'Attitude towards bats','SARS-CoV-2 transmitter','100% SARS-CoV-2 carrier',...
    'Ecological bat culling','Scientific bat culling'};
%--------- lecture effect ---------
ngroups = 2; % groups of the explanatory varibale
for kk = 1:5
    %subplot(3,2,kk)
    if kk <= 2
        axes(axh_fig5(2,kk+1))
    else
        axes(axh_fig5(1,kk-2))
    end

    X = [(1:ngroups)',repmat(Xmd(2:end),ngroups,1)];
    [pihat,dlow,dhi] = mnrval(Rstat.(['B',num2str(kk+4)]),X,Rstat.(['stats',num2str(kk+4)]
),'Model','Ordinal');
```

```
    ctrs = 1:size(pihat,2);
    hBar = bar(ctrs, pihat'*100,'Linewidth',1);

    hBar(1).FaceColor = [0 177 210]/255;
    hBar(2).FaceColor = [253 219 39]/255;

    ctr = nan(length(hBar),length(ctrs));
    ydt = ctr;
    for k1 = 1:length(hBar)
        ctr(k1,:) = bsxfun(@plus, hBar(1).XData, [hBar(k1).XOffset]');
        ydt(k1,:) = hBar(k1).YData;
    end
    hold on
    ctr = ctr';
    ydt = ydt';
    for i = 1:size(ctr,1)
        err = errorbar(ctr(i,:), ydt(i,:), dlow(:,i)*100, dhi(:,i)*100,'linestyle','none',
'color','k','linewidth',1);
    end

    ylim([0,100])
    if kk == 5
        lgstrs = {'Prelecture','Postlecture'};
        [lg,lgobj] = legend({'',''});
        %lg.Title.String = 'Gender';
        lg.LineWidth = 1;
        lg.Location = 'northeast';
        lg.Position = lg.Position + [0,0,0.02,0];
        lg.Color = 'none';
        offs = linspace(0.27,0.09,length(lgobj)/2);
        for i = length(lgobj)/2+1:length(lgobj)
            off = offs(i-length(lgobj)/2);
            lgobj(i).Children.XData = lgobj(i).Children.XData.*0.3+0.03;
            lgobj(i).Children.YData = lgobj(i).Children.YData.*0.6+off;
        end
        text(2.36,77,lgstrs,'FontName',FN,'FontSize',FS)
        %text(3.54,104,'Attitude to bats','FontName',FN,'FontSize',FS,'Fontw','Bold')
    end

    if kk == 1
        xtls = {'Negative','Neutral','Positive'};
    else
        xtls = {'Disagree','Neutral','Agree'};
    end

    set(gca,'xticklabel',xtls,'LineWidth',1,'FontName',FN,'FontSize',FS)
    xlabel(xlbs{kk},'FontName',FN,'FontSize',FS)
    if kk == 3
        ylabel({'Proportion of', 'participants (%)'},'FontName',FN,'FontSize',FS)
    end

    % attitude to human actions: original percentage and difference after the lecture
    Result.s2.hmaction.(['par',num2str(kk)]) = [pihat;diff(pihat)];
    %diff(pihat)
    box off

    x = get(gca,'xlim');
    y = get(gca,'ylim');
    lts = {'D','E','F','G','H'};
    text(x(1)+0.1,y(2)*1,lts{kk},'FontName',FN,'FontSize',FS+2,'Fontw','Bold')
```

```
    y0 = 85;
    dy = -15;
    t = Rstat.(['stats',num2str(kk+4)]).t(3); % t value for lecture
    p = Rstat.(['stats',num2str(kk+4)]).p(3); % p value for lecture
    if p < 0.001
        pstr = 'p < 0.001';
    elseif p < 0.01
        pstr = 'p < 0.01';
    elseif p < 0.05
        pstr = 'p < 0.05';
    else
        pstr = ['p = ', num2str(p,2)];
    end

    if kk == 2
        xpos = 1.2;
    else
        xpos = 2.8;
    end

    if kk == 5
        y0 = 50;
    end

    text(xpos,y0,['t = ', num2str(t,3)],'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz'
,'Center')
    text(xpos,y0+dy,pstr,'FontName',FN,'FontSize',FS,'Fontw','Bold','Horiz','Center')

end

tvalabs = nan(5,6);
pvals = tvalabs;
for i = 5:9
    tvalabs(i-4,:) = Result.s2.hmaction.stats.(['stats',num2str(i)]).t;
    pvals(i-4,:) = Result.s2.hmaction.stats.(['stats',num2str(i)]).p;
end

print(fig5,'-dtiff','-r300',[pathfig,'fig5_intervention'])
```



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