Psychtoolbox编程2

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- 记时及记录反应
- 心理学实验程序结构
- PTB实验编程实例

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- 记时及记录反应
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记时及记录反应

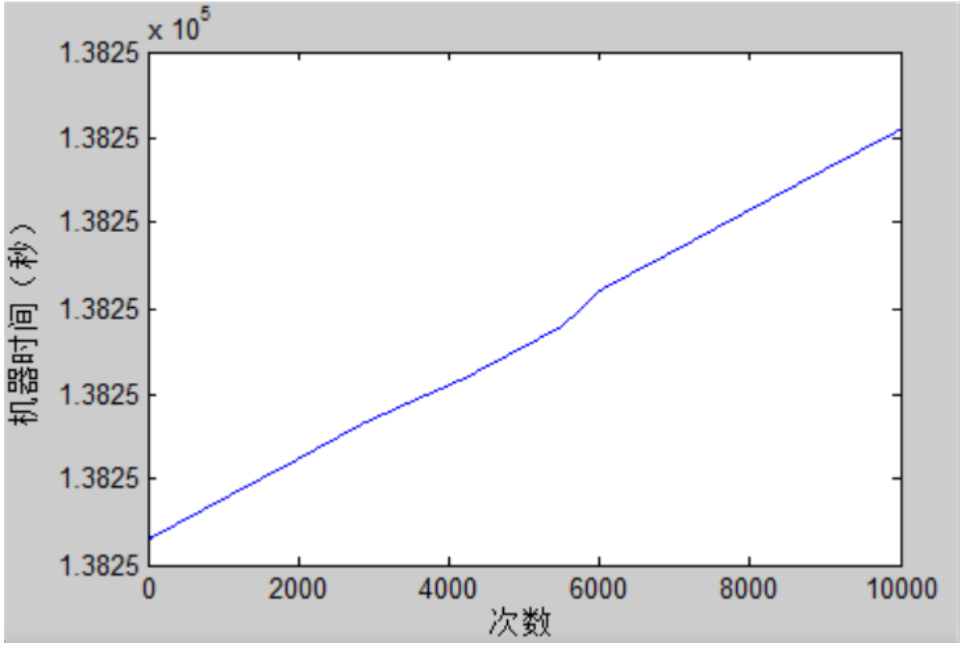
- 计时命令(时间精度达毫秒级)：
  s=GetSecs, 获取当前的机器时间并赋值给S；
  WaitSecs(t),等待t秒钟，再继续执行后续命令；

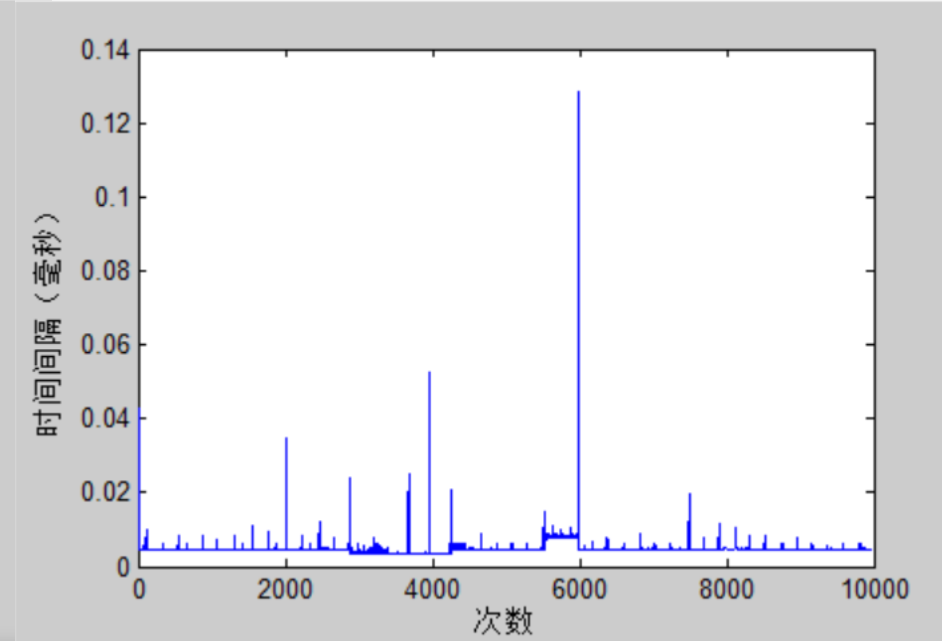
%example2_1 测试GetSecs命令

```
%测试GetSecs命令，展示计时的波动性
Times=zeros(1,10000);
for i=1:10000
  Times(i)=GetSecs;
end

figure(1)
plot(Times);
xlabel('次数')
ylabel('机器时间（秒）')

figure(2);
plot(diff(Times)*1000)
xlabel('次数')
ylabel('时间间隔（毫秒）')
```

%example2_2 测试WaitSecs命令

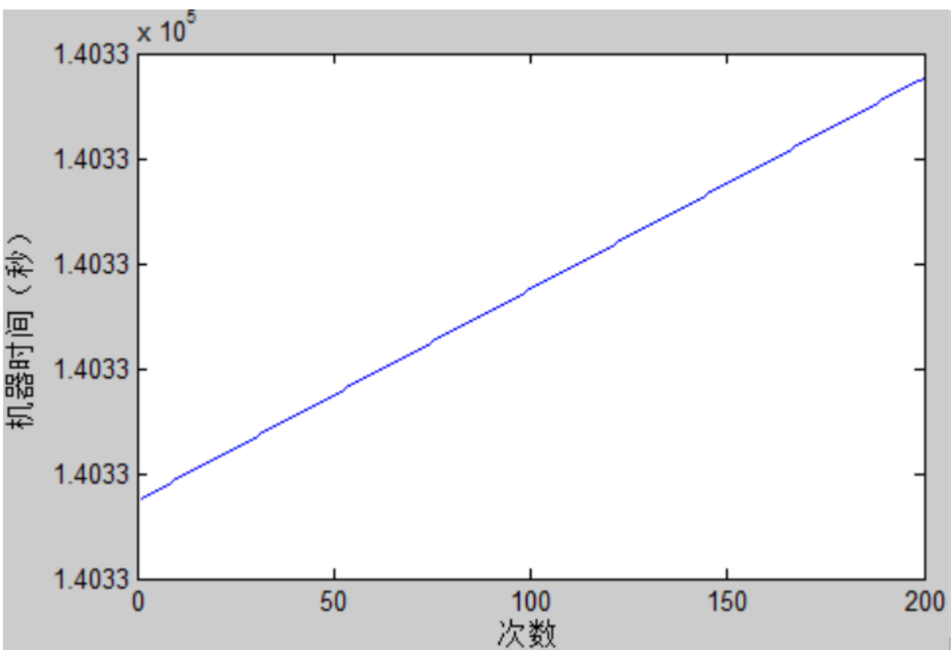
```
%测试WaitSecs命令，展示计时的波动性
Times=zeros(1,200);
for i=1:200
  Times(i)=GetSecs;
  WaitSecs(0.010);%等待10毫秒
end

figure(1)
plot(Times);
xlabel('次数')
ylabel('机器时间（秒）')
figure(2);
plot(diff(Times)*1000)
xlabel('次数')
ylabel('时间间隔（毫秒）')
```

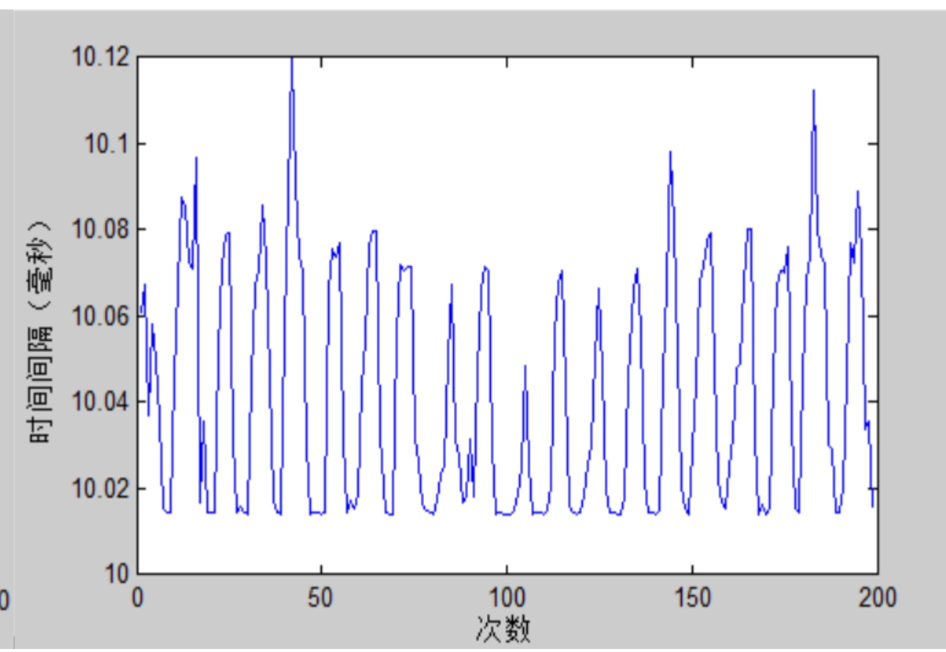




Plot(Times)

Plot(diff(Times)*1000)





- 提高时间精度：关闭系统自动更新，关闭杀毒程序；
- Windows系统的时间精度 < MacOS < Linux ;
- 不要用Matlab自带的计时命令（如tic， toc等）；
- 不要用WaitSecs来精确控制刺激呈现的时间；

不精确的时间控制

```
…….
StimDur=0.2;
画刺激
Screen('Flip')
WaitSecs(0.2)
……..
```

精确的时间控制

```
…….
StimDur=0.2;
Frames= StimDur /framerate
For ii=1: Frames
      画刺激
      Screen('Flip')
end
……..
```

◘ 键盘记录命令

[keyIsDown, secs, keyCode] = KbCheck;

- KeyIsDown，是否有按键按下，0或1；secs，按键按下时的机器时间（精度高）；keyCode，键盘值；
- Keycode：是数组 1×256，无按键时，所有元素都为零。有按键时，对应的元素为1；

0	0	0	0	0	●●●	1	0	●●●
1	2	3				65		

KEYa=KbName('a');

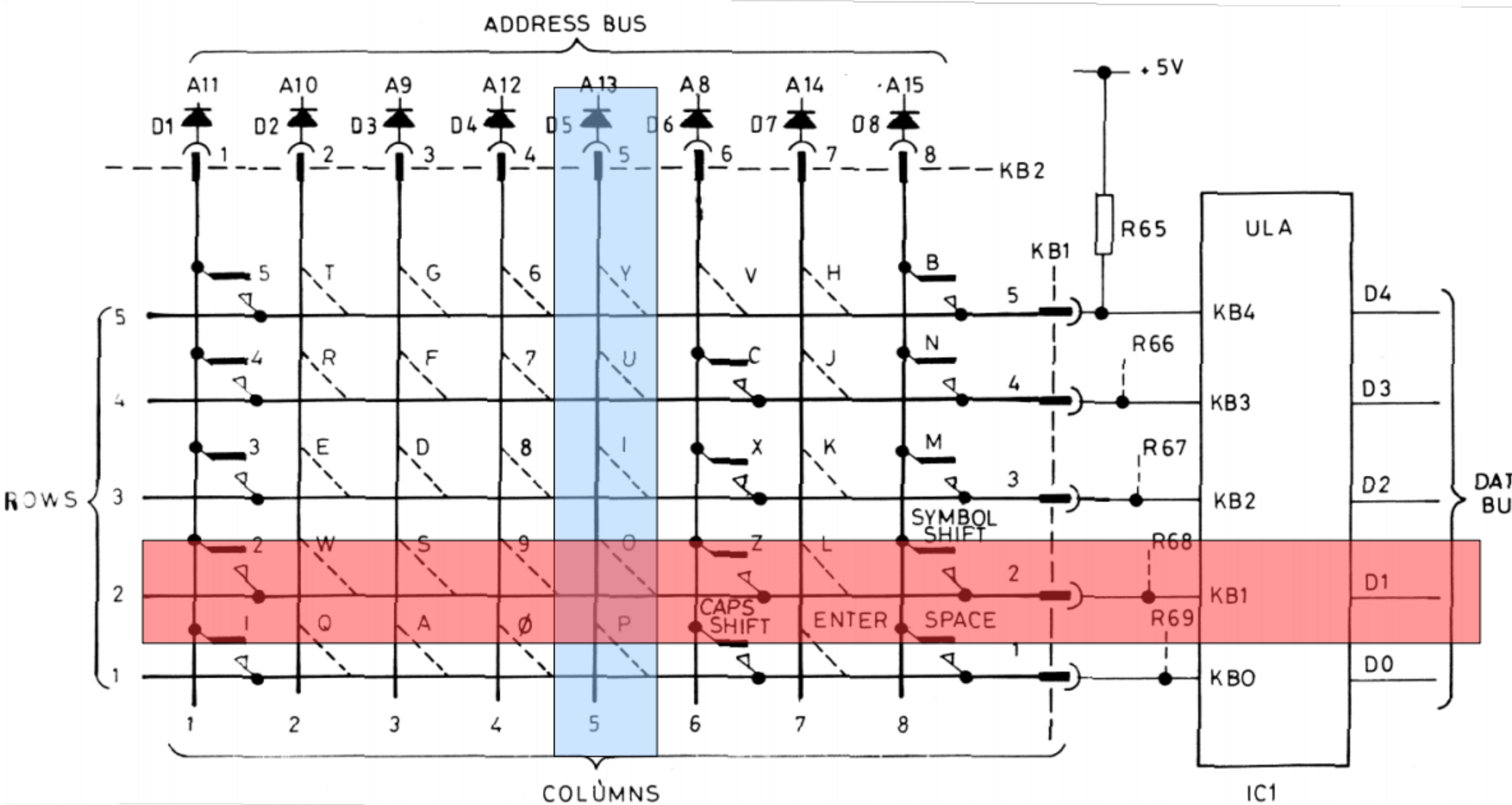
若keyCode(KEYa)为1则表明a键被按下

%example2_3 测试KbCheck命令,在屏幕上显示按键的键值及键符，按Esc键退出循环。

```
%在屏幕上显示按键的键值及键符，按Esc键退出循环
fprintf('Press any key(s). Press escape key to exit.\n');
while KbCheck; end % 等待没有按键被按下
escapekey = KbName('esc');%esc键对应的键值
while 1
    keyisdown = 0;
    while ~keyisdown
        [keyisdown, secs, keycode] = KbCheck;
        % WaitSecs(0.001); % delay to prevent CPU hogging
    end
    fprintf('Current key(s) down: %s which is %s\n',...
        char(int2str(find(keycode))),char(KbName(keycode))');%显示键值及按键符号
    if keycode(escapekey) %遇到esc键时则退出循环
        break;
    end
    while KbCheck; end % wait until all keys are released
end
```

- KbCheck并不适合用于记录反应时；

KbCheck的计时误差 = 按键行程误差（~20ms）+ USB通信误差（~10ms）+ 键盘扫描误差（~20ms）= 50ms



键盘由16列*8行线路阵列组成，计算机轮流扫描每列线路的电压值来确定按下的按键，扫描周期8-20ms（依赖于键盘编码方式）.

- 鼠标记录命令

[x,y,buttons] = GetMouse

- x, y分别为鼠标的竖直位置和水平位置对应的像素；buttons是三个按键的按键状态，1为按下，0为松开。

- 用鼠标作为反应时测量设备比键盘更准确。

%example2_4 转动的风车，位置由鼠标位置确定，转动速度由上下方向键调节。

```
%画一个转动的风车，风车位置由鼠标确定，速度可通过
%By Cai Yongchun, 2020/10/8
ScreenNumber=0;
Background=128;
[WindowPtr,windowRect]=Screen('OpenWindow',ScreenNumber,Background);
frame_rate=Screen('FrameRate',WindowPtr);%获取刷新率
framedur=1/frame_rate;%每一帧呈现的时间

%刺激的参数
StimContrast=0.45; %对比度
StimSize=300;%刺激大小
[x,y]=meshgrid(-StimSize/2:StimSize/2,-StimSize/2:StimSize/2);
maskradius=StimSize/2;
sd=50;
Circlemask=exp(-(x.^2+y.^2)/(2*sd^2));%生成三维高斯mask
Circlemask=(x.^2+y.^2 <= maskradius^2);%生成圆形mask
cycles=6;
RotationSpeed=0;%初始转动角速度，单位度/秒
RStep=20;%每按一次上下方向键速度改变的值
increasing=0;
buttoms=[];
upkey=KbName('up');
downkey=KbName('down');
rotatingangle=0;
%%呈现光栅
while ~sum(buttoms) %按鼠标任意键退出
    [xx yy buttoms]=GetMouse;
    [keyisdown, secs, keycode] = KbCheck;
    StimRect=[0 0 StimSize StimSize]+[xx yy xx yy];%刺激的位置每帧都更新

    rotatingangleperframe=RotationSpeed/frame_rate;%每帧角度的变化量
    rotatingangle=rotatingangle+rotatingangleperframe;%每帧的角度
```

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心理学实验程序的典型结构

- 实验主程序：呈现刺激、记录反应

1、初始化：打开一个窗口，将在此窗口内呈现视觉刺激，定义刺激参数；

2、画刺激：在打开的窗口内生成视觉刺激；

3、记录反应：记录被试的按键反应；

4、保存数据，包括刺激参数、反应数据等；

循环N个trial

5、退出：关闭刺激窗口，回到命令窗口。

- 参数矩阵程序：生成每个试次(trial)参数

试次序号

反应时

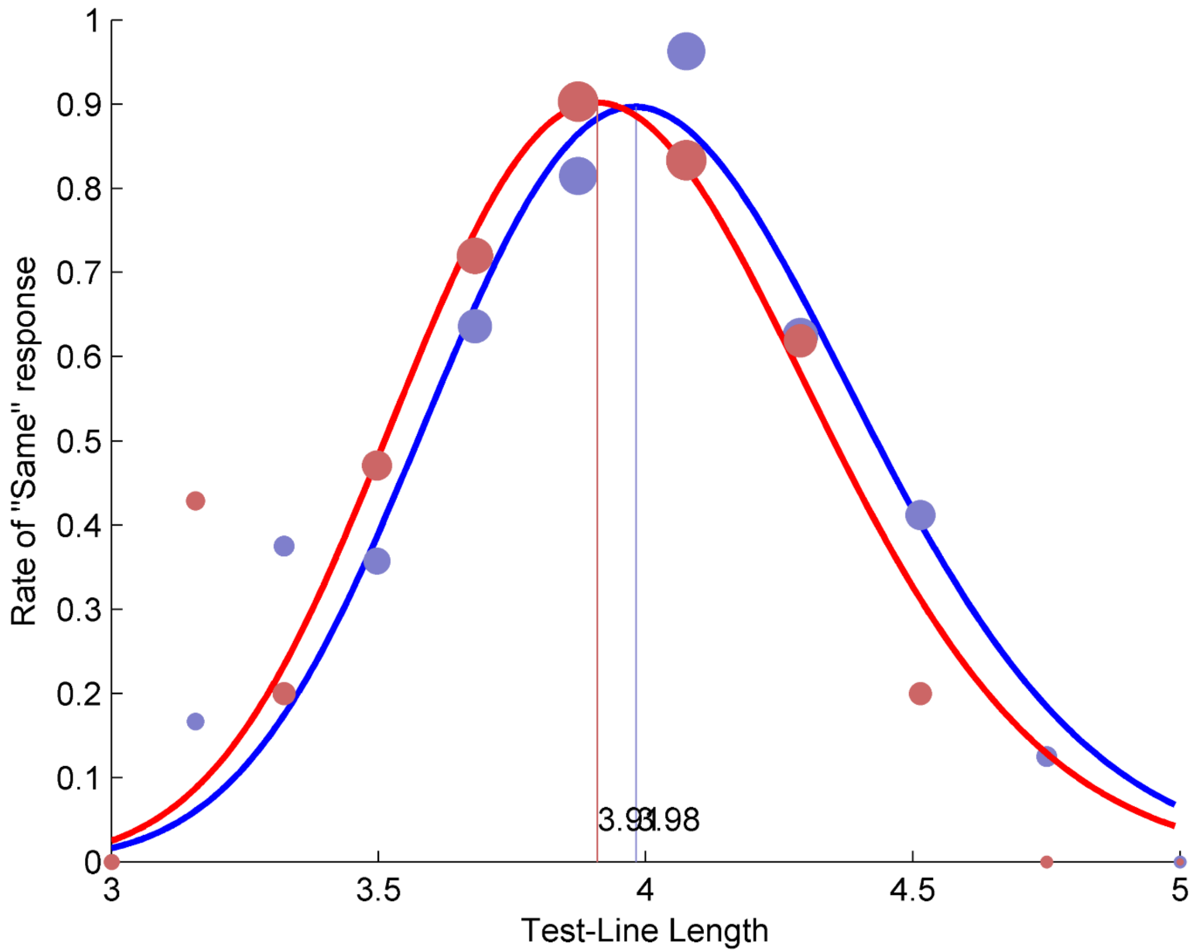
paramatrix

256x13 double

1	2	3	4	5	6	7	8	9	10	11
1	2	1	-1	-1	-45	7	3	1	1	595.4378
2	2	1	-1	-1	45	7	3	1	1	480.8704
3	3	-1	-1	1	45	8	4	1	1	495.3324
4	4	-1	-1	1	-45	9	6	-1	1	351.253[illegible]
5	1	-1	1	-1	-45	2	7	-1	1	476.0[illegible]15
6	1	-1	-1	1	45	7	2	-1	1	507.0889
7	1	-1	1	-1	-45	2	7	-1	1	423.9467
8	3	1	-1	-1	45	8	4	1	1	394.1003
9	1	-1	-1	[illegible]	[illegible]	7	2	-1	1	491.5579
10	3	-1	1	-1	-45	4	8	1	1	448.0751
11	2	-1	1	-1	-45	3	7	1	1	441.5291
12	3	-1	-1	1	45	8	4	1	1	444.2767
13	2	1	1	1	-45	3	7	1	1	354.1291
14	3	-1	1	-1	-45	4	8	1	1	934.5795
15	2	1	-1	-1	-45	7	3	1	1	533.7677
16	3	-1	-1	1	-45	8	4	1	1	479.1548
17	2	-1	-1	1	45	7	3	1	1	438.0255
18	2	1	-1	-1	-45	7	3	1	1	462.5272
19	4	1	-1	-1	-45	9	6	-1	1	423.4794
20	3	1	-1	-1	45	8	4	1	1	479.0551

刺激参数

- 结果计算程序：计算每个被试的结果(各实验条件的平均反应时、正确率、阈值测量曲线等）。



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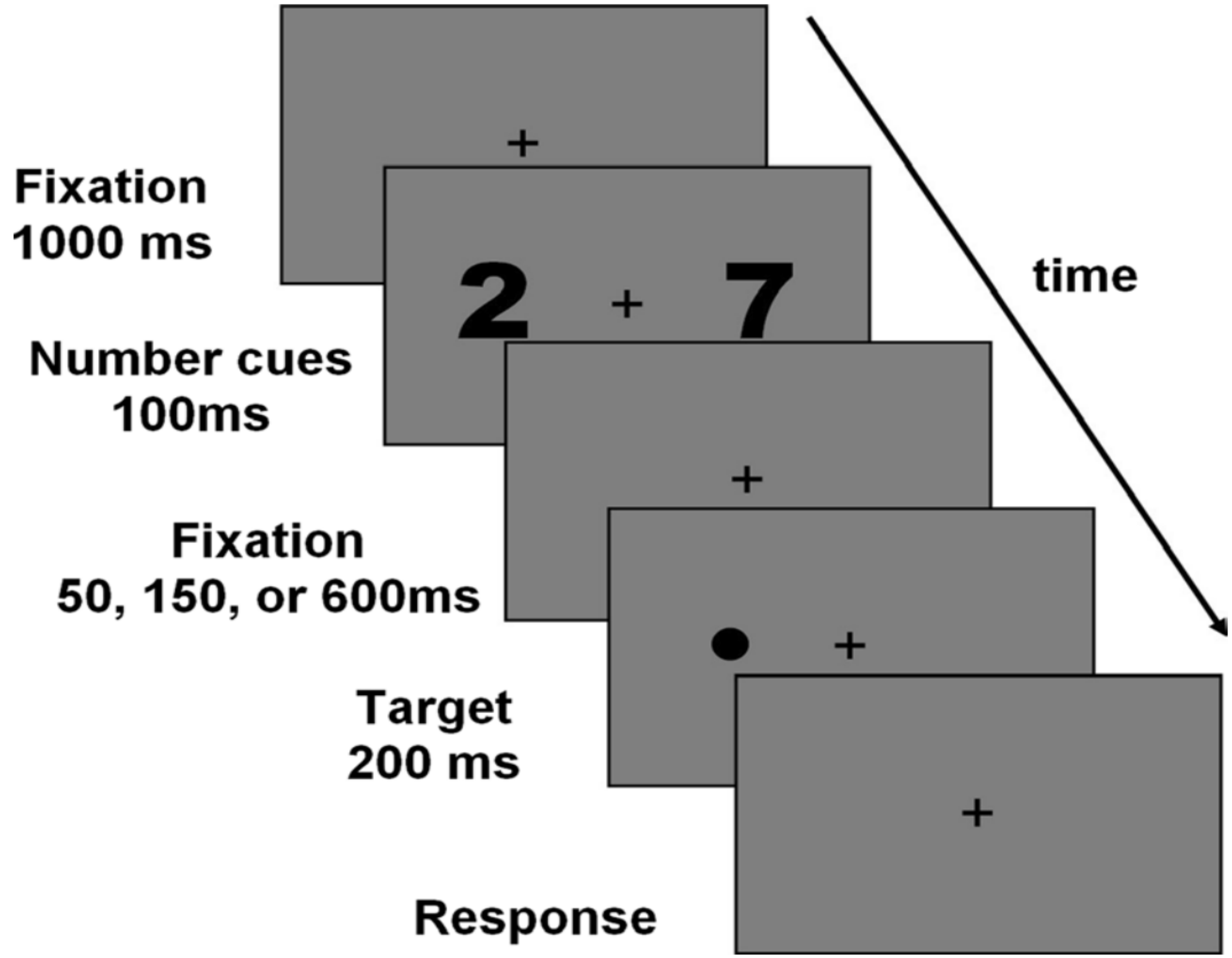
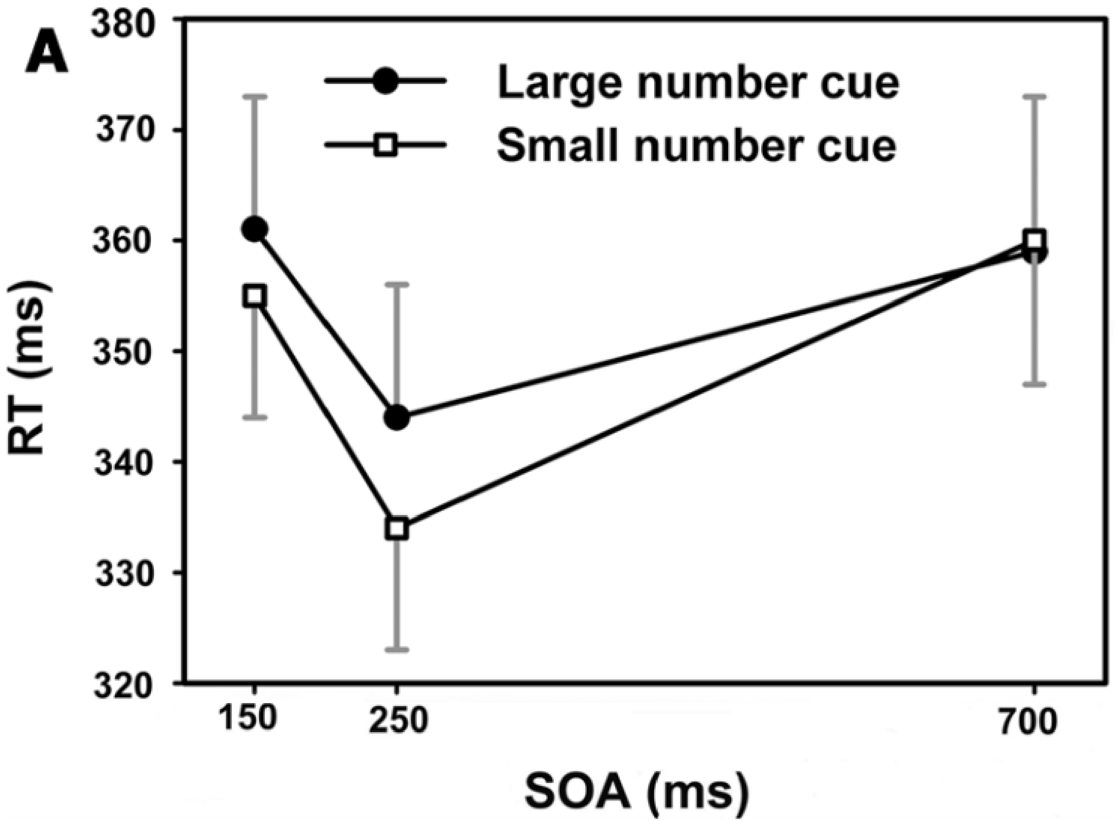
研究实例1：小数字的注意优势效应(Cai & Li, 2015)



Cai, Y. C., and Li, S. X. (2015). Small number preference in guiding attention. Experimental Brain Research. 233, 539–550. doi: 10.1007/s00221-014-4134-3



被试对小数字之后的目标反应更快，
表明小数字更加吸引注意。

主程序

num_attention.m

编辑器 发布 视图

```
%%2020 10 13
%%by Cai Yongchun
%%小数2 3 4  大数7 8 9   一共9对数字对
%%不同大小的数字吸引注意，detection任务

function num_attention(subjectid,start,over)

    load([subjectid '_paramatrix']); %%导入参数矩阵paramatri

    background=128;

    %%openwindow
    [windowPtr, windowRect]=Screen('OpenWindow', 0, backgrou
    HideCursor;
    hz=Screen('FrameRate',windowPtr);%获取当前刷新率
    framedur=1/hz;%单位，秒

    fixation_dur=1000;%duration of fixation, 1000ms
    cue_dur=100;%duration of cue, 100ms
    target_dur=200;%duration of target, 200ms

    fix_size=[12 4];
    cue_size=65;%数字cue的大小
    target_w=16;%目标宽度
    target_l=16;%目标长度
    hoffset=200;%horizontal offset,左右两侧cue偏离中心注视点
```

num_attention 行 115 列 33

参数矩阵程序

buildmatrix.m

编辑器 发布 视图

buildmatrix.m

```
%%column1 sequence number
%%column2 condition number
%%column3 validation of cue:valid or invalide,大数字默认为有
%%column4 location of large number cue: left or right
%%column5 location of target:left or right
%%column6 是否是catch trial，是为1 不是为0
%%column7 左侧的数字
%%column8 右侧的数字
%%column9 （暂未指定意义）
%%column10 catch trial是否按键
%%column11 目标判断的反应时
%%column12 isi duration between offset of cue and onset of t

numbercondition=1:9;%一共9对数字
cuevalidity=[1 -1];%cue的有效性
cuelocation=[1 -1];%cue的位置
ISIdur=[150 600];%cue到target之间的时间间隔


trialpercondition=3;%每种情况下的trial数3（每一个空间位置）
numofcue=length(numbercondition);%数字cue的个数
catchtrials=48;%catchtrial（只呈现cue，不呈现目标刺激，被试不
col=12;%参数矩阵一共多少列
numcue=[2 7;2 8;2 9;...
        3 7;3 8;3 9;...
        4 7;4 8;4 9];%9对数字对
```

脚本 行 8 列 16

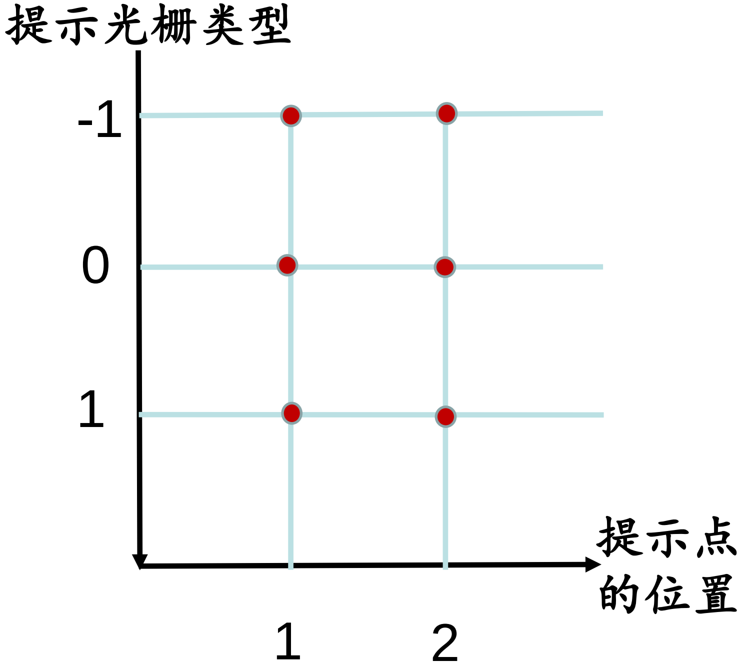
[X1,X2,...,Xn] = ndgrid(c1,c2,...,cn)

N 维空间中的矩形网格

- 例：提示点左侧、中间、右侧随机呈现标准光栅或测试光栅；
  - 3（左侧、上面、右侧）*2（标准光栅、测试光栅）的设计；

    -1 0 1 1 2

提示点的位置	提示光栅类型
-1	1
0	1
1	1
-1	2
0	2
1	2




```
C1=[-1 0 1];
C2=[1 2];
[X1,X2] = ndgrid(C1,C2)
```

X1 =

-1	-1
0	0
1	1

X2 =

1	2
1	2
1	2

```
combinedpara=[X1(:),X2(:)]
```

combinedpara =

-1	1
-1	2
0	1
0	2
1	1
1	2

研究实例2：运动的周边抑制效应 (Tadin et al, 2003)

Only button presses occurring between 250 and 1,000 ms after target pair onset were accepted as correct detections. False alarms for the adjacent condition were defined as button presses occurring in response to a target presented at only one of the attended locations. For the separate conditions, false alarms were defined as button presses in response to a target presented in only one of the attended locations and/or in the intermediate to-be-ignored position. Target detection rates, reaction times and false alarms were tested by one factor repeated measures analysis of variance (experimental condition).

Received 3 April; accepted 27 May 2003; doi:10.1038/nature01812.

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Perceptual consequences of centre–surround antagonism in visual motion processing

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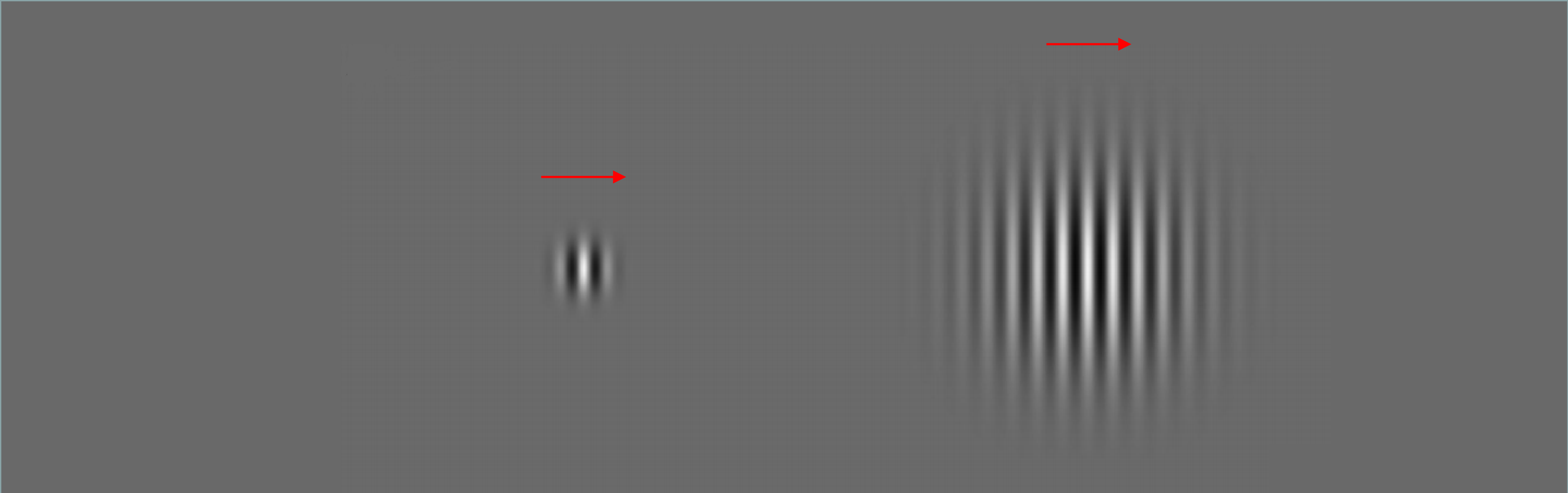
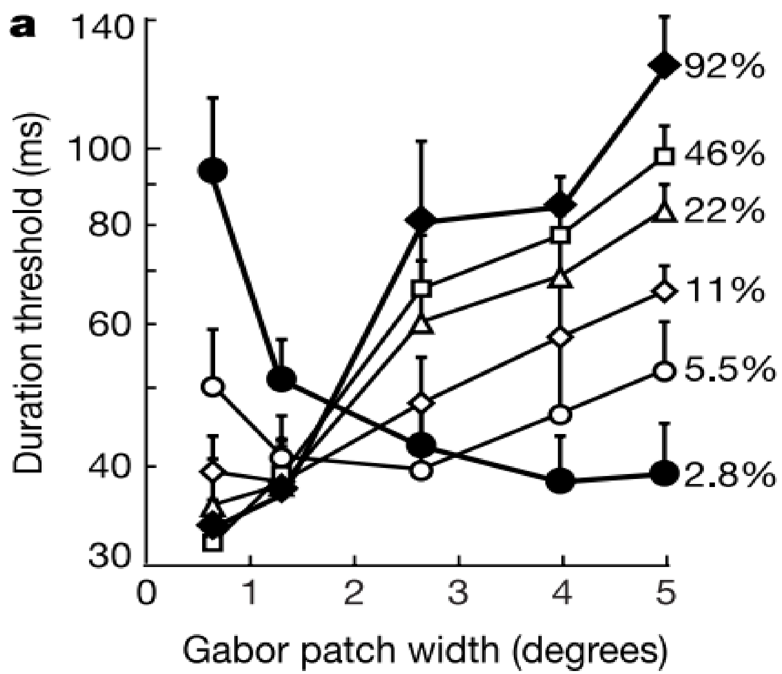
Vanderbilt Vision Research Center, Vanderbilt University, 111 21st Avenue South, Nashville, Tennessee 37203, USA

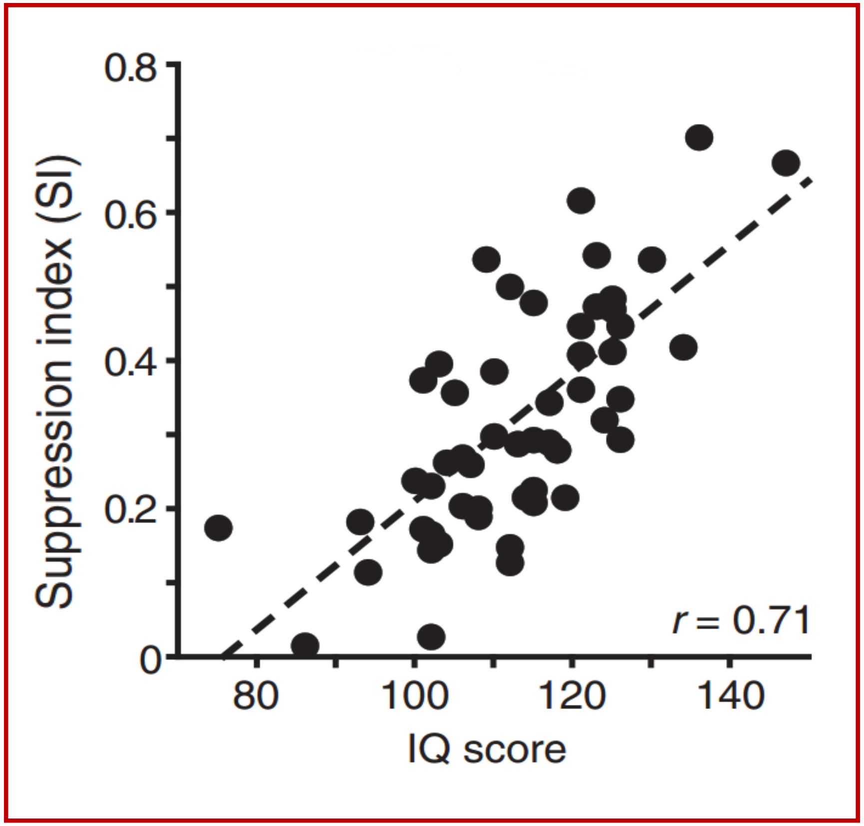
Centre–surround receptive field organization is a ubiquitous property in mammalian visual systems, presumably tailored for extracting image features that are differentially distributed over space[1]. In visual motion, this is evident as antagonistic interactions between centre and surround regions of the receptive fields of many direction-selective neurons in visual cortex[2–6]. In a series of psychophysical experiments we make the counterintuitive observation that increasing the size of a high-contrast moving pattern renders its direction of motion more difficult to perceive and reduces its effectiveness as an adaptation stimulus. We propose that this is a perceptual correlate of centre–surround antagonism, possibly within a population of neurons in the middle temporal visual area. The spatial antagonism of motion signals observed at high contrast gives way to spatial summation as contrast decreases. Evidently, integration of motion signals over space depends crucially on the visibility of those signals, thereby allowing the visual system to register

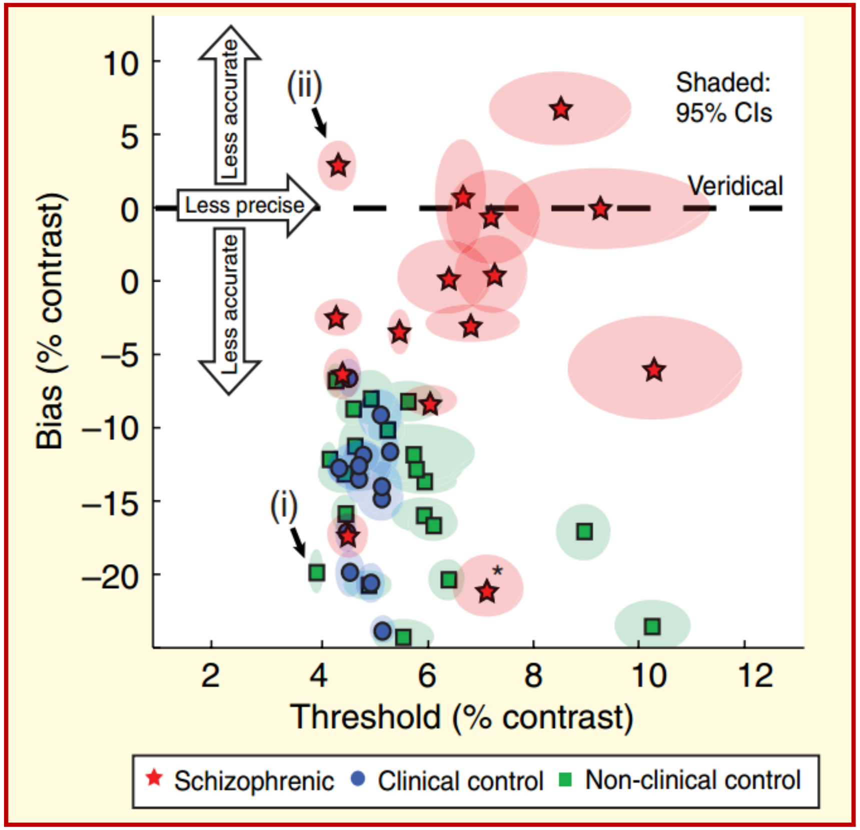
Tadin, D., Lappin, J. S., Gilroy, L. A., & Blake, R. (2003). Perceptual consequences of centre- surround antagonism in visual motion processing. Nature, 424(6946), 312–315.



被试对大光栅(高对比度)的运动方向判断更困难







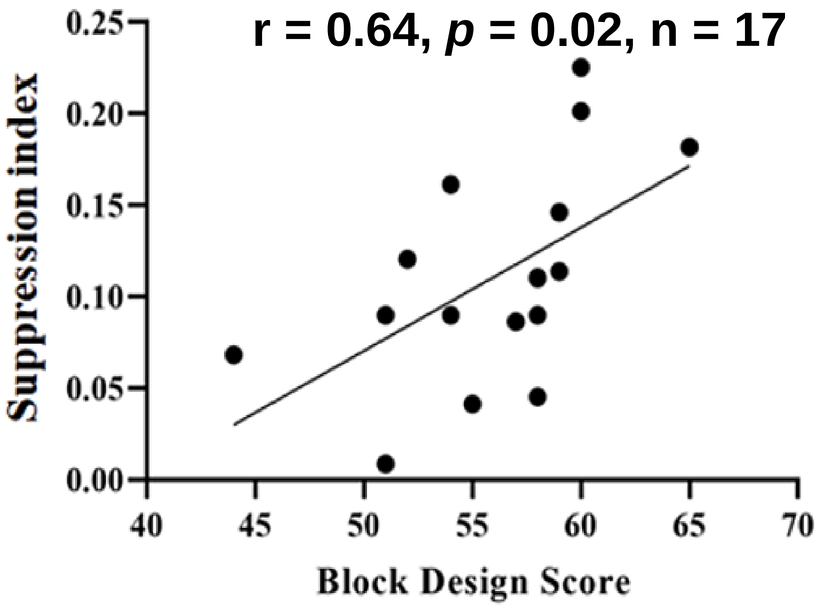
周边抑制与智商

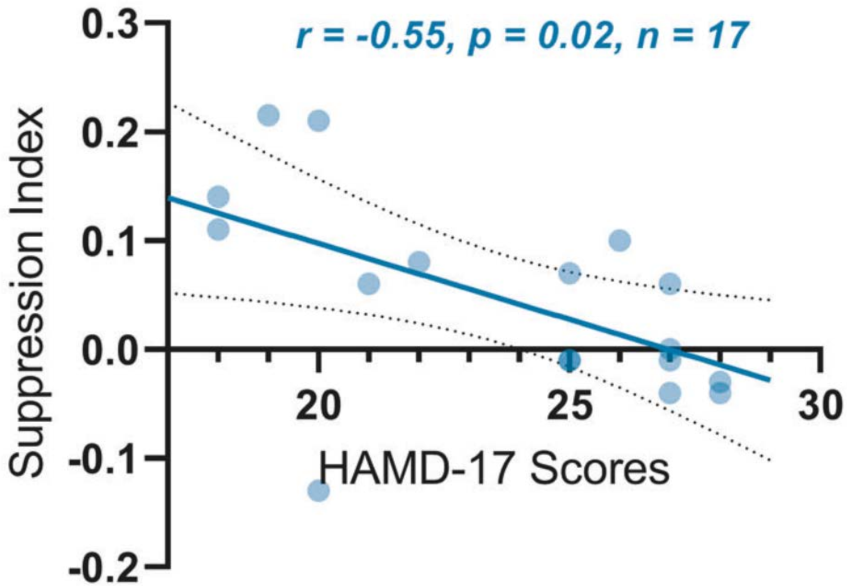
（Melnick, et al, 2013）

周边抑制与精神分裂症

（Dakin, et al, 2005）

我们的研究也得到了相似的结果





周边抑制与空间智商任务正相关

(Gao, Cai, Song, et al, *In preparation*)

周边抑制与抑郁指数负相关

(Song,… Cai, et al, 2021, *Molecular psychiatry*)

主程序：SS_motion_Gabor.m

生成光栅矩阵：driftGabormatrix.m

阶梯法测阈值：updownstaircase.m

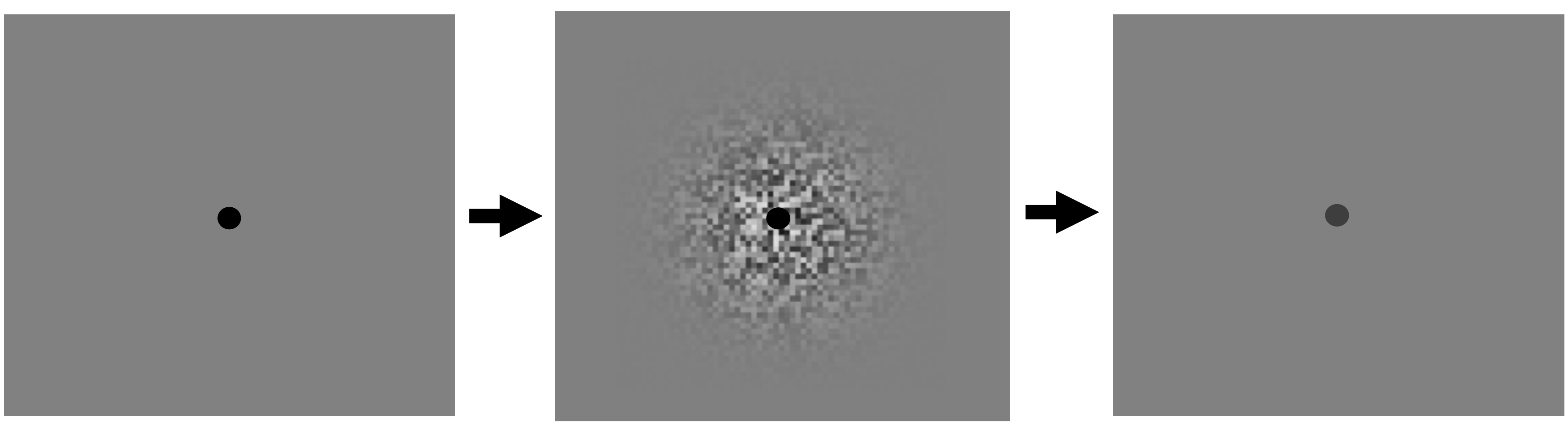
生成参数矩阵：buildmatrix.m

实验结果拟合：fittingresult_SS.m

谢谢各位！

大作业：编一个测试运动周边抑制现象的程序

在屏幕中央首先呈现500毫秒的注视点，然后呈现100毫秒的运动（运动速度4度视角/秒）的圆形随机点噪音，噪音的边缘高斯模糊，噪音的运动方向向左或向右，被试通过按键快速判断随机点的运动方向，记录反应时。圆形随机点分为大（模糊噪音的sd=2度视角）、中（sd=1.2度视角）、小（ sd=0.4度视角）三种情况。本研究的目的是考察被试对不同大小的运动随机点的方向判断反应时是否存在差异。因为存在运动周边抑制，预期结果是随着刺激大小增加，判断逐渐变慢。



500ms
注视点

100ms
大、中、运动随机点

等待按键

要求：应包含主程序 和 生成参数矩阵的buildmatrix程序，以及你自己的实验数据和结果。实验结果曲线用plot命令画出，横轴为光栅大小，纵轴为被试判断运动方向的反应时（正确的试次）。注意：需要把视角转换成像素。

评分标准：

- 程序能否正确运行： 50%
- 程序是否实现作业要求的功能；40%
- 程序是否优化（可读性、结构的合理性、语句的美观性）；10%