第一部分：主效应和交互效应检验

[Excel]：

两因素（3*4）混合实验计算表

ABS表

		B1	B2	B3	B4	Σ
A1	S11	22	15	10	5	52
	S21	16	13	9	5	43
	S31	18	13	7	5	43
	S41	20	15	8	4	47
A2	S12	23	20	15	12	70
	S22	24	21	16	12	73
	S32	18	15	12	9	54
	S42	19	15	12	10	56
A3	S13	16	13	9	7	45
	S23	21	18	13	10	62
	S33	19	13	10	8	50
	S43	19	15	11	7	52

AB表

	B1	B2	B3	B4	Σ
	n=4				
A1	76	56	34	19	185
A2	84	71	55	43	253
A3	75	59	43	32	209
Σ	235	186	132	94	

基本量的计算

		647		235		132		185
	[Y]=	8721.020833	SSA(b1)水平[Y]	4602.083333	SSA(b3)水平[Y]	1452	SSB(a1)水平[Y]	2139.0625
	[ABS]=	9995	SSA(b1)水平[ABS]	4673	SSA(b3)水平[ABS]	1534	SSB(a1)水平[ABS]	2637
	[AS]=	8991.25		186		94		253
	[A]=	8869.6875	SSA(b2)水平[Y]	2883	SSA(b4)水平[Y]	736.3333333	SSB(a2)水平[Y]	4000.5625
	[B]=	9673.416667	SSA(b2)水平[ABS]	2966	SSA(b4)水平[ABS]	822	SSB(a2)水平[ABS]	4319
	[AB]=	9844.75						209
平方和SS的计算			交互作用误差项值				SSB(a3)水平[Y]	2730.0625
	SS总变异=	1273.979167	SSA(b1)总变异=	70.91666667			SSB(a3)水平[ABS]	3039
	SS被试间=	270.2291667	SSA(b2)总变异=	83				
	SSA=	148.6666667	SSA(b3)总变异=	82				
	SS被试(A)=	121.5625	SSA(b4)总变异=	85.66666667				
	SS被试内=	1003.75						
	SSB=	952.3958333	SSB(a1)总变异=	497.9375				
	SSAB=	22.66666667	SSB(a2)总变异=	318.4375				
	SS B*被试（A）=	28.6875	SSB(a3)总变异=	308.9375				

方差分析表

变异来源	平方和SS		自由度df	均方MS	F	
1.被试间	270.2291667	np-1=	11			
2.A(词表语义相关性)	148.6666667	p-1=	2	74.33333333	5.503341902	*
3.被试(A)	121.5625	p(n-1)=	9	13.50694444		
4.被试内	1003.75	np(q-1)=	36			
5.B(回忆时间)	952.3958333	q-1=	3	317.4652778	298.7908497	**
6.AB	22.66666667	(p-1)(q-1)=	6	3.777777778	3.555555556	**
7.B*被试（A）	28.6875	p(n-1)(q-1)=	27	1.0625		
8.总计	1273.979167		47			

F0.01(2,9)=8.02

F0.05(2,36)=3.26

F0.01(3,27)=4.60

F0.01(6,27)=3.56

F0.05(6,27)=2.46

[SPSS]:

Tests of Between-Subjects Effects

Measure MEASURE_1

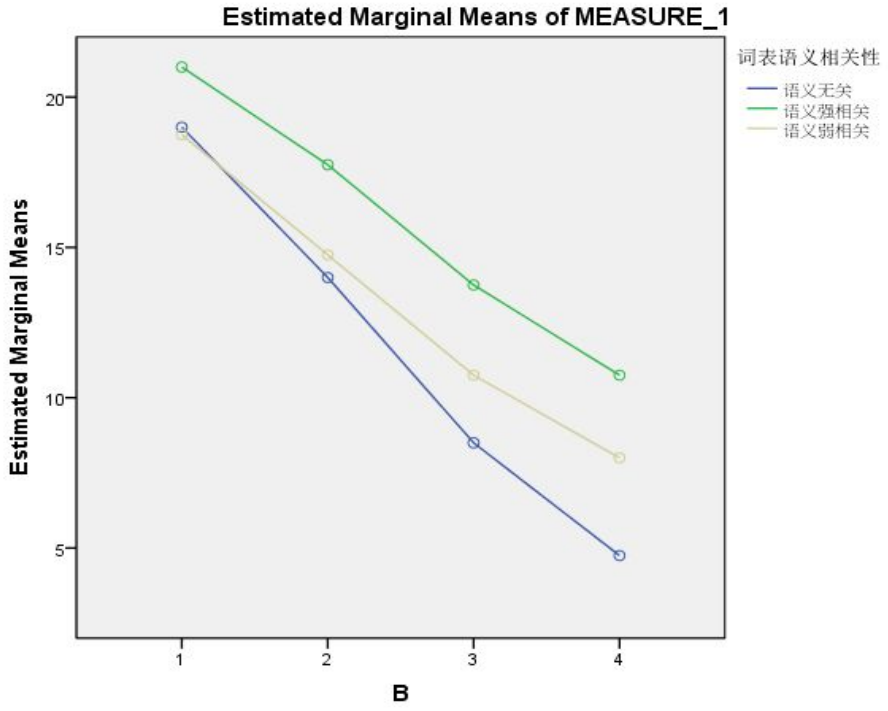
Transformed Variable Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	8721.021	1	8721.021	645.669	.000
A	148.667	2	74.333	5.503	.027
Error	121.563	9	13.507		

Tests of Within-Subjects Effects

Measure MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
B	Sphericity Assumed	952.396	3	317.465	298.791	.000
	Greenhouse-Geisser	952.396	1.963	485.151	298.791	.000
	Huynh-Feldt	952.396	3.000	317.465	298.791	.000
	Lower-bound	952.396	1.000	952.396	298.791	.000
B * A	Sphericity Assumed	22.667	6	3.778	3.556	.010
	Greenhouse-Geisser	22.667	3.926	5.773	3.556	.027
	Huynh-Feldt	22.667	6.000	3.778	3.556	.010
	Lower-bound	22.667	2.000	11.333	3.556	.073
Error(B)	Sphericity Assumed	28.687	27	1.062		
	Greenhouse-Geisser	28.687	17.668	1.624		
	Huynh-Feldt	28.687	27.000	1.062		
	Lower-bound	28.687	9.000	3.187		



第二部分：简单效应检验

【excel】

计算交互作用				
方向一A因素在B因素4个水平				
	SSA(在b1水平)组间=	12.16666667		
	SSA(在b2水平)组间=	31.5		
	SSA(在b3水平)组间=	55.5		
	SSA(在b4水平)组间=	72.16666667		
	SSA(b1+b2+b3+b4)=	171.3333333	等于SSA+SSAB=	171.3333333
(参考上面简单效应基本量)				
	SSA(b1)单元内error=	58.75		
	SSA(b2)单元内error=	51.5		
	SSA(b3)单元内error=	26.5		
	SSA(b4)单元内error=	13.5		
方向二B因素在A因素3个水平				
	SSB(在a1水平)=	468.1875		
	SSB(在a2水平)=	242.1875		
	SSB(在a3水平)=	264.6875		
	SSB(a1+a2+a3)=	975.0625	等于SSB+SSAB=	975.0625

含简单效应方差分析表

变异来源	平方和SS		自由度df	均方MS	F	
1.被试间	270.2291667	np-1=	11			
2.A(词表语义相关性)	148.6666667	p-1=	2	74.33333333	5.503341902	*
3.被试(A)	121.5625	p(n-1)=	9	13.50694444		
4.被试内	1003.75	np(q-1)=	36			
5.B(回忆时间)	952.3958333	q-1=	3	317.4652778	298.7908497	**
6.AB	22.66666667	(p-1)(q-1)=	6	3.777777778	3.555555556	**
7.B*被试（A）残差	28.6875	p(n-1)(q-1)=	27	1.0625		
8.SSA(在b1水平)	12.16666667	p-1=	2	6.083333333	0.931914894	
9.SSA(在b2水平)	31.5	p-1=	2	15.75	2.752427184	
10.SSA(在b3水平)	55.5	p-1=	2	27.75	9.424528302	**
11.SSA(在b4水平)	72.16666667	p-1=	2	36.08333333	24.05555556	**
SSA(b1)error=	58.75	p(n-1)=	9	6.527777778		
SSA(b2)error=	51.5	p(n-1)=	9	5.722222222		
SSA(b3)error=	26.5	p(n-1)=	9	2.944444444		
SSA(b4)error=	13.5	p(n-1)=	9	1.5		
12.SSB(在a1水平)	468.1875	q-1=	3	156.0625	146.8823529	**
13.SSB(在a2水平)	242.1875	q-1=	3	80.72916667	75.98039216	**
14.SSB(在a3水平)	264.6875	q-1=	3	88.22916667	83.03921569	**
8.总计	1273.979167		47			
F0.01(2,9)=	8.02					
F0.05(2,9)=	4.26					
F0.01(3,12)=	5.95					
F0.05(3,12)=	3.49					

【spss】

简单效应检验 A 在 B 各水平：

```
* * * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- Design  2
* * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN B(1)' Within-Subject Effect.

 Tests of Significance for T1 using UNIQUE sums of squares
 Source of Variation          SS      DF       MS        F  Sig of F

 WITHIN+RESIDUAL           58.75       9     6.53
 MWITHIN B(1)            4602.08       1  4602.08   705.00      .000
 A BY MWITHIN B(1)         12.17       2     6.08      .93      .429

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
* * * * * * * * * * * * * * * * * A n a l y s i s  o f  V a r i a n c e -- Design  2
* * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN B(2)' Within-Subject Effect.

 Tests of Significance for T2 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            51.50       9      5.72
 MWITHIN B(2)             2883.00       1   2883.00    503.83      .000
 A BY MWITHIN B(2)          31.50       2     15.75      2.75      .117

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
* * * * * * * * * * * * * * * * * A n a l y s i s  o f  V a r i a n c e -- Design  2
* * * * * * * * * * * * * * * * * *

Tests involving 'MWITHIN B(3)' Within-Subject Effect.

 Tests of Significance for T3 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            26.50       9      2.94
 MWITHIN B(3)             1452.00       1   1452.00    493.13      .000
 A BY MWITHIN B(3)          55.50       2     27.75      9.42      .006

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
* * * * * * * * * * * * * * * * * A n a l y s i s  o f  V a r i a n c e -- Design  2

Tests involving 'MWITHIN B(4)' Within-Subject Effect.

 Tests of Significance for T4 using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL            13.50       9      1.50
 MWITHIN B(4)             736.33       1    736.33    490.89      .000
 A BY MWITHIN B(4)          72.17       2     36.08     24.06      .000

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - -
```

简单效应 B 在 A 各水平：

```
* * * * * * * * * * * * * * * * * A n a l y s i s   o f   V a r i a n c e -- Design  2
* * * * * * * * * * * * * * * * *

Tests involving 'B' Within-Subject Effect.

 AVERAGED Tests of Significance for B using UNIQUE sums of squares
 Source of Variation          SS      DF        MS         F  Sig of F

 WITHIN+RESIDUAL           28.69      27      1.06
 MWITHIN A(1) BY B        468.19       3    156.06    146.88      .000
 MWITHIN A(2) BY B        242.19       3     80.73     75.98      .000
 MWITHIN A(3) BY B        264.69       3     88.23     83.04      .000

 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - - -
```

第三部分：多重比较

```
GLM B1 B2 B3 B4 BY A
 /WSFACTOR=B 4  Polynomial
 /METHOD=SSTYPE(3)
 /PLOT=PROFILE(B*A)
/EMMEANS=TABLES(A*B)COMPARE(A) ADJ(SIDAK)
/EMMEANS=TABLES(A*B)COMPARE(B) ADJ(SIDAK)
 /EMMEANS=TABLES(OVERALL)
 /PRINT=DESCRIPTIVE HOMOGENEITY
 /CRITERIA=ALPHA(.05)
/WSDESIGN=B
 /DESIGN=A.
```

Univariate Tests

Measure MEASURE_1

B		Sum of Squares	df	Mean Square	F	Sig.
1	Contrast	12.167	2	6.083	.932	.429
	Error	58.750	9	6.528		
2	Contrast	31.500	2	15.750	2.752	.117
	Error	51.500	9	5.722		
3	Contrast	55.500	2	27.750	9.425	.006
	Error	26.500	9	2.944		
4	Contrast	72.167	2	36.083	24.056	.000
	Error	13.500	9	1.500		

Each F tests the simple effects of 词表语义相关性 within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Pairwise Comparisons

Measure MEASURE_1

词表语义相关性	(I) B	(J) B	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
1	1	2	5.000*	.640	.000	2.855	7.145
		3	10.500*	.777	.000	7.895	13.105
		4	14.250*	.975	.000	10.982	17.518
	2	1	-5.000*	.640	.000	-7.145	-2.855
		3	5.500*	.553	.000	3.648	7.352
		4	9.250*	.808	.000	6.543	11.957
	3	1	-10.500*	.777	.000	-13.105	-7.895
		2	-5.500*	.553	.000	-7.352	-3.648
		4	3.750*	.514	.000	2.029	5.471
	4	1	-14.250*	.975	.000	-17.518	-10.982
		2	-9.250*	.808	.000	-11.957	-6.543
		3	-3.750*	.514	.000	-5.471	-2.029
2	1	2	3.250*	.640	.004	1.105	5.395
		3	7.250*	.777	.000	4.645	9.855
		4	10.250*	.975	.000	6.982	13.518
	2	1	-3.250*	.640	.004	-5.395	-1.105
		3	4.000*	.553	.000	2.148	5.852
		4	7.000*	.808	.000	4.293	9.707
	3	1	-7.250*	.777	.000	-9.855	-4.645
		2	-4.000*	.553	.000	-5.852	-2.148
		4	3.000*	.514	.001	1.279	4.721
	4	1	-10.250*	.975	.000	-13.518	-6.982
		2	-7.000*	.808	.000	-9.707	-4.293
		3	-3.000*	.514	.001	-4.721	-1.279
3	1	2	4.000*	.640	.001	1.855	6.145
		3	8.000*	.777	.000	5.395	10.605
		4	10.750*	.975	.000	7.482	14.018
	2	1	-4.000*	.640	.001	-6.145	-1.855
		3	4.000*	.553	.000	2.148	5.852
		4	6.750*	.808	.000	4.043	9.457
	3	1	-8.000*	.777	.000	-10.605	-5.395
		2	-4.000*	.553	.000	-5.852	-2.148
		4	2.750*	.514	.003	1.029	4.471
	4	1	-10.750*	.975	.000	-14.018	-7.482
		2	-6.750*	.808	.000	-9.457	-4.043
		3	-2.750*	.514	.003	-4.471	-1.029

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Sidak.

Pairwise Comparisons

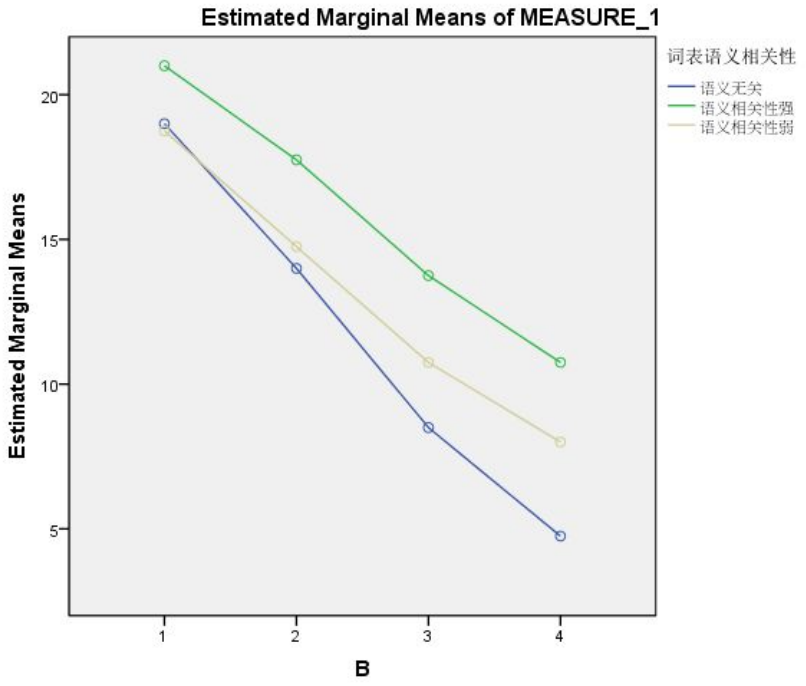
Measure MEASURE_1

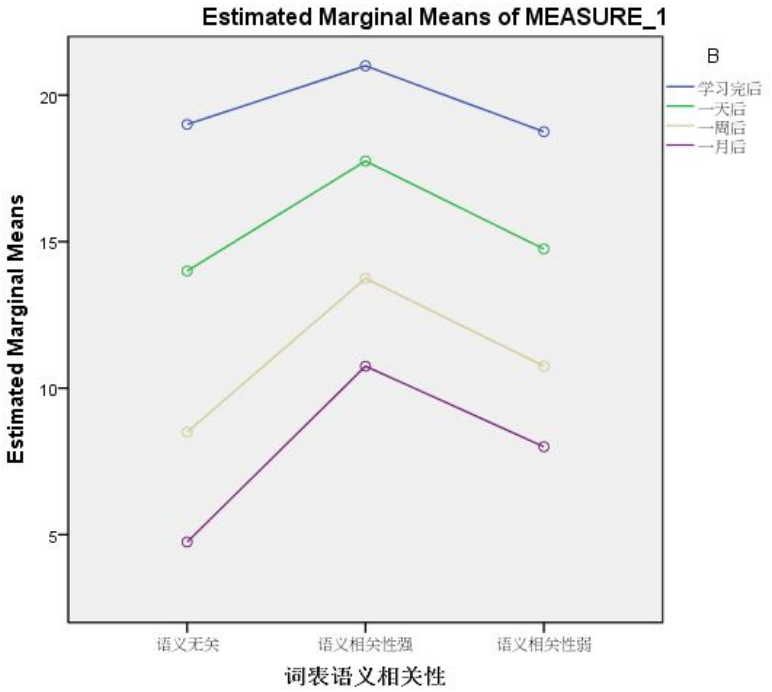
B	(I) 词表语义相关性	(J) 词表语义相关性	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
						Lower Bound	Upper Bound
1	1	2	-2.000	1.807	.653	-7.281	3.281
		3	.250	1.807	.999	-5.031	5.531
	2	1	2.000	1.807	.653	-3.281	7.281
		3	2.250	1.807	.569	-3.031	7.531
	3	1	-.250	1.807	.999	-5.531	5.031
		2	-2.250	1.807	.569	-7.531	3.031
2	1	2	-3.750	1.691	.153	-8.694	1.194
		3	-.750	1.691	.963	-5.694	4.194
	2	1	3.750	1.691	.153	-1.194	8.694
		3	3.000	1.691	.295	-1.944	7.944
	3	1	.750	1.691	.963	-4.194	5.694
		2	-3.000	1.691	.295	-7.944	1.944
3	1	2	-5.250*	1.213	.006	-8.796	-1.704
		3	-2.250	1.213	.263	-5.796	1.296
	2	1	5.250*	1.213	.006	1.704	8.796
		3	3.000	1.213	.103	-.546	6.546
	3	1	2.250	1.213	.263	-1.296	5.796
		2	-3.000	1.213	.103	-6.546	.546
4	1	2	-6.000*	.866	.000	-8.531	-3.469
		3	-3.250*	.866	.014	-5.781	-.719
	2	1	6.000*	.866	.000	3.469	8.531
		3	2.750*	.866	.033	.219	5.281
	3	1	3.250*	.866	.014	.719	5.781
		2	-2.750*	.866	.033	-5.281	-.219

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Sidak.





【文字描述】

手工计算与 spss 计算结果一致。

方差分析结果表明，所学习词表的语义相关性（A 因素）的主效应在统计上不显著（F(2,9)=5.503,P>0.01），回忆测验时间（B 因素）的主效应在统计上非常显著（F(3,27)=298.790,P<0.01），表明回忆测验与学习之间时间间隔越长成绩越差；词表语义相关性与回忆测验时间的交互作用接近非常显著（F(6,27)=3.556,P>0.01，P<0.05），表明回忆测验时间因素（学习后、一天后、一周后、一个月后）与语义相关性（语义无关、语义弱相关、语义强相关）存在交互作用；

通过简单效应分析得出：一，在回忆测验时间为一周后和一个月后时，测验得分随语义相关性增加而增加，再进一步具体来看，测验时间为一周后时，仅有语义无关与语义相关性强差异显著，即一周后测验时，语义相关性强的得分显著高于语义无关；二，无论语义相关性为何种关系时，测验得分随测验时间增加而减少。