有两个自变量和两个中介变量的结构方程模型

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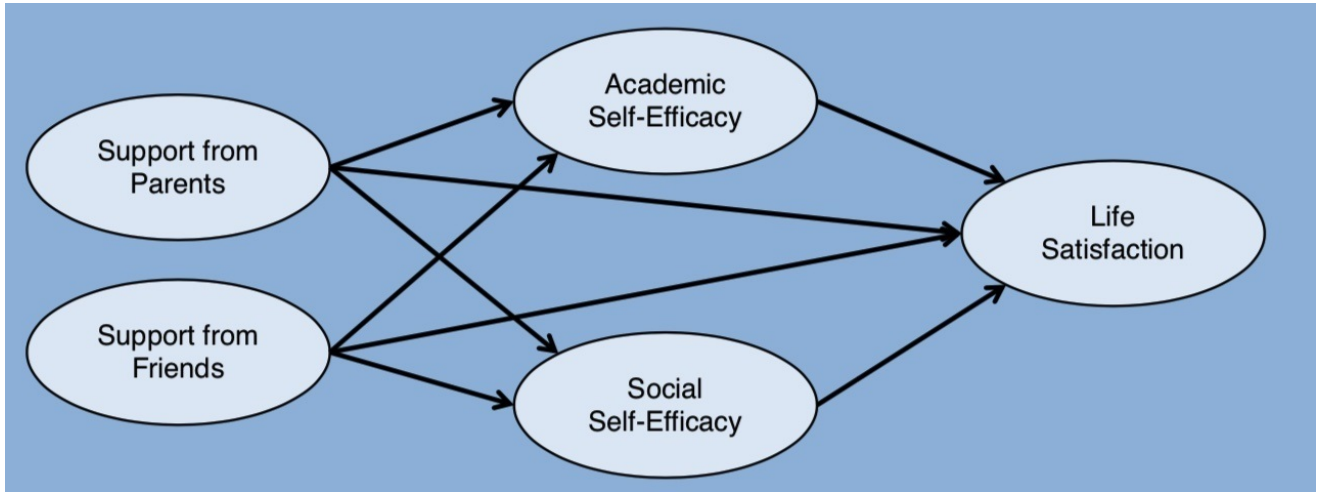
导言

研究内容

青少年所经历的父母和朋友的情感支持对他们生活满意度的影响。

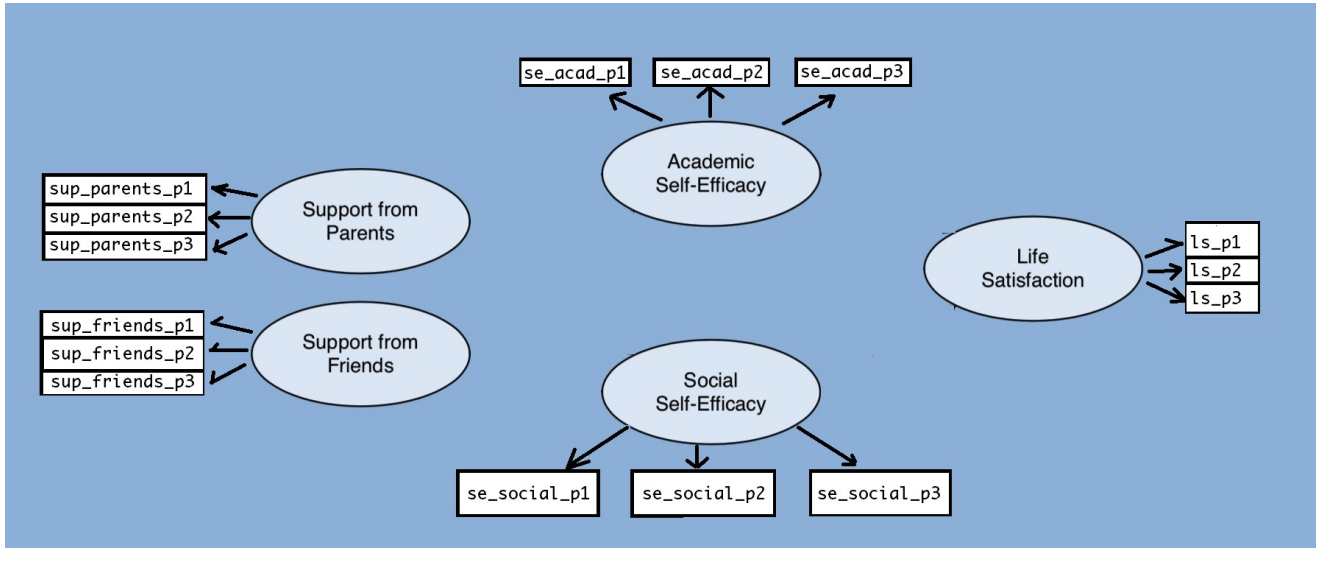


理论假设

- 父母的支持和朋友的支持都对生活满意度有积极影响。
- 同时，“学术自我效能”和“社会自我效能”这两个自我效能将成为这些效应的中介。

构念

验证性因子分析（CFA）




```
library(lavaan)
model_measurement <- "
  SUP_Parents =~ sup_parents_p1 + sup_parents_p2 + sup_parents_p3
  SUP_Friends =~ sup_friends_p1 + sup_friends_p2 + sup_friends_p3
  SE_Academic =~ se_acad_p1 + se_acad_p2 + se_acad_p3
  SE_Social   =~ se_social_p1 + se_social_p2 + se_social_p3
  LS          =~ ls_p1 + ls_p2 + ls_p3

"
fit_cfa <- cfa(model_measurement, data = d)
```

CFA之因子载荷

检验这些“构念”拟合的好坏

```
fit_cfa %>%
  parameterEstimates(standardized = TRUE) %>%
  filter(op == "=~") %>%
  select(lhs, rhs, std.all)
```

结果显示，因子载荷都大于0.7，满足要求。

lhs	rhs	std.all
SUP_Parents	sup_parents_p1	0.8336
SUP_Parents	sup_parents_p2	0.8978
SUP_Parents	sup_parents_p3	0.7923
SUP_Friends	sup_friends_p1	0.8673
SUP_Friends	sup_friends_p2	0.8456
SUP_Friends	sup_friends_p3	0.8352
SE_Academic	se_acad_p1	0.8557
SE_Academic	se_acad_p2	0.8373
SE_Academic	se_acad_p3	0.8242
SE_Social	se_social_p1	0.8158
SE_Social	se_social_p2	0.8790
SE_Social	se_social_p3	0.7318
LS	ls_p1	0.6389
LS	ls_p2	0.7720
LS	ls_p3	0.6090

CFA之拟合指标

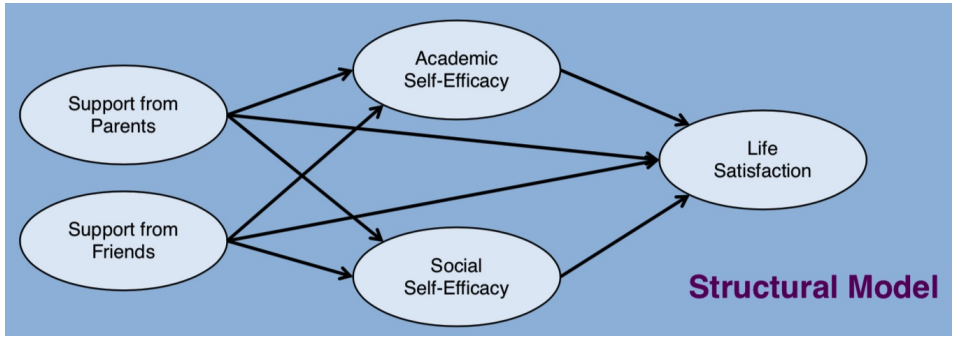
```
fit_cfa %>%
  fitMeasures(output = "matrix") %>%
  as.data.frame()
```

index	value
chisq	212.2819
df	80.0000
pvalue	0.0000
cfi	0.9380
tli	0.9186
rmsea	0.0805
rmsea.ci.lower	0.0675
rmsea.ci.upper	0.0938
srmr	0.0623
aic	7,100.0506
bic	7,241.7012

结果显示 CFI = 0.938，TLI = 0.919在阈值线0.95/0.95左右，此外 RMSEA = 0.08，其90% 置信区间是[0.07; 0.09]，并不明显高于参考线0.1, 此外 SRMR = 0.06 也表明模型拟合的不错 (SRMR < 0.08)。

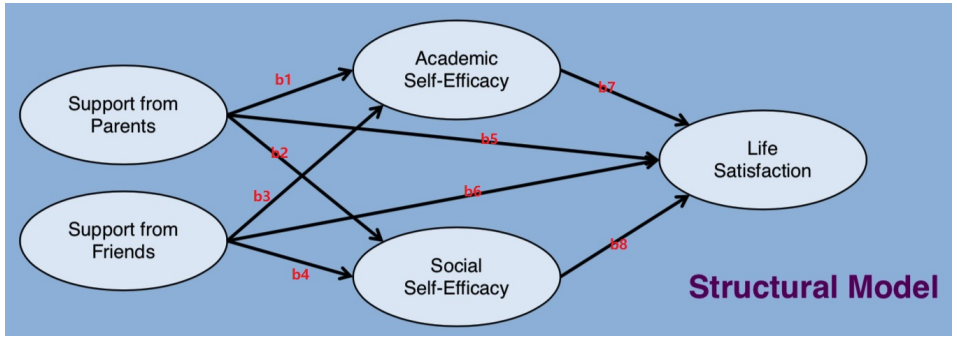
结构模型

代码



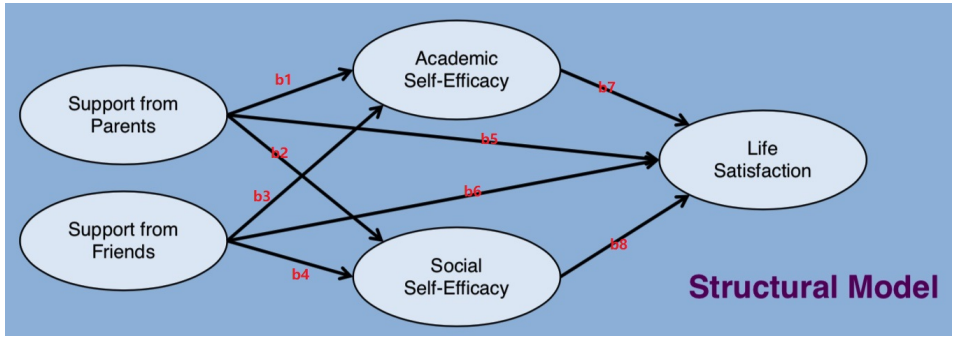

```
model <- "
# Measurement model
  SUP_Parents =~ sup_parents_p1 + sup_parents_p2 + sup
  SUP_Friends =~ sup_friends_p1 + sup_friends_p2 + sup
  SE_Academic =~ se_acad_p1 + se_acad_p2 + se_acad_p3
  SE_Social   =~ se_social_p1 + se_social_p2 + se_soci
  LS          =~ ls_p1 + ls_p2 + ls_p3

# Regressions
  SE_Academic ~ SUP_Parents + SUP_Friends
  SE_Social   ~ SUP_Parents + SUP_Friends
  LS          ~ SE_Academic + SE_Social + SUP_Parents


"
```

代码（标注了系数）



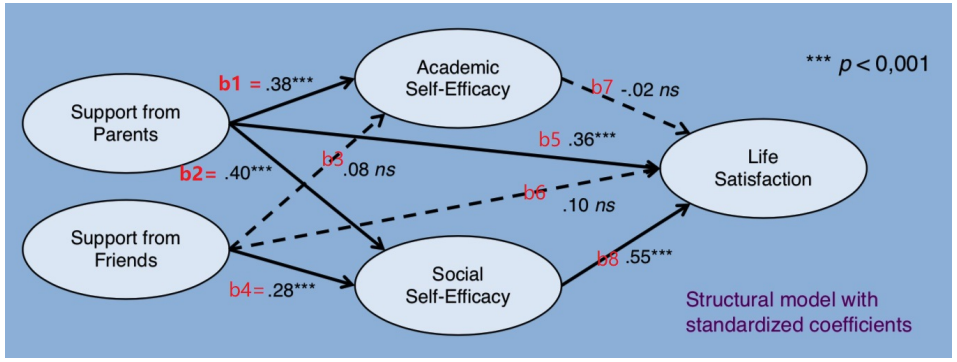

```
model <- ″
# Measurement model
  SUP_Parents =~ sup_parents_p1 + sup_parents_p2 + sup
  SUP_Friends =~ sup_friends_p1 + sup_friends_p2 + sup
  SE_Academic =~ se_acad_p1 + se_acad_p2 + se_acad_p3
  SE_Social   =~ se_social_p1 + se_social_p2 + se_soci
  LS          =~ ls_p1 + ls_p2 + ls_p3

# Regressions
  SE_Academic ~ b1*SUP_Parents + b3*SUP_Friends
  SE_Social   ~ b2*SUP_Parents + b4*SUP_Friends
  LS          ~ b5*SUP_Parents + b6*SUP_Friends + b7*S

″
```

代码（增加了效应计算）



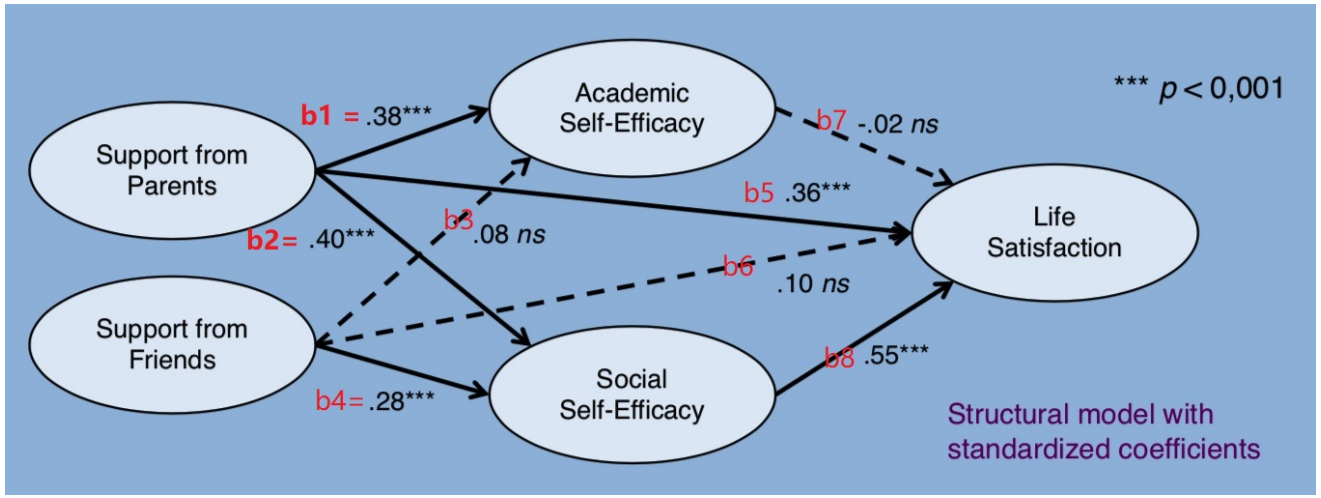

```
model <- ''
# Measurement model
  SUP_Parents =~ sup_parents_p1 + sup_parents_p2 + sup
  SUP_Friends =~ sup_friends_p1 + sup_friends_p2 + sup
  SE_Academic =~ se_acad_p1 + se_acad_p2 + se_acad_p3
  SE_Social   =~ se_social_p1 + se_social_p2 + se_soci
  LS          =~ ls_p1 + ls_p2 + ls_p3

# Regressions
  SE_Academic ~ b1*SUP_Parents + b3*SUP_Friends
  SE_Social   ~ b2*SUP_Parents + b4*SUP_Friends
  LS          ~ b5*SUP_Parents + b6*SUP_Friends + b7*S

# Residual covariances
  SE_Academic ~~ SE_Social

# Indirect effects
  b1b7             := b1*b7
  b2b8             := b2*b8
  total_ind_parent := b1*b7 + b2*b8
  b3b7             := b3*b7
  b4b8             := b4*b8
  total_ind_friend := b3*b7 + b4*b8
```

计算结果



label	est	se	z	pvalue	ci.lower	ci.upper	std.all
b1	0.326	0.068	4.823	0.000	0.202	0.468	0.384
b2	0.290	0.055	5.223	0.000	0.189	0.411	0.399
b3	0.066	0.058	1.149	0.250	-0.046	0.180	0.083
b4	0.194	0.043	4.555	0.000	0.109	0.279	0.284
b5	0.247	0.062	4.003	0.000	0.124	0.367	0.359
b6	0.061	0.043	1.442	0.149	-0.021	0.150	0.095
b7	-0.014	0.109	-0.131	0.896	-0.224	0.197	-0.018
b8	0.519	0.134	3.862	0.000	0.251	0.770	0.549
total_ind_parent	0.146	0.038	3.861	0.000	0.076	0.222	0.212
total_ind_friend	0.100	0.030	3.310	0.001	0.044	0.164	0.154
total_parent	0.392	0.074	5.319	0.000	0.245	0.528	0.571
total_friend	0.161	0.047	3.446	0.001	0.074	0.259	0.249

结论



- （total_parent vs total_friend）父母的支持对年轻人的生活满意度最重要，父母支持是朋友支持的两倍多
- （b2*b8显著）父母的支持对年轻人的生活满意度，也通过社会自我效能产生间接效应
- （b5，b6, b7 都不显著，只有b4*b8显著）朋友支持对生活满意度只有间接影响（通过社会自我效能感）
- （b7不显著，b8显著）学业自我效能与生活满意度关联性不大，社会自我效能感是生活满意度的最强预测因子

下一步工作

CFA and SEM with multiple groups

- Measurement invariance analysis across multiple groups
- Multi-group analyses for the structural model (moderation analyses)
- Moderated mediation analysis

谢谢大家!