Social TV Project

Zichun Liu, Tianwen Huan, Sijia Li

TF mentor: Jun Li; Professor mentor: Masanao Yajima

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1 Introduction

In this project, our client Cansu Sogut from Marketing Department in Questrom School of Business is interested in the relationship between participating in social TV and enjoyment. She also considered connectedness as the mediator and the engagement types as the moderator. Our client designed the experiment and collected the data. Our team mainly focused on helping our client conduct the mediation analysis and analyze the result of her experiment.

By using the experimental data, the analysis result shows that participating in social TV will help to decrease one's enjoyment. The mediator has a positive influence and the moderator has no influence.

This report is organized as follows. Section 2 introduces the experiment and the methods we used for this analysis. Section 3 introduces the three questions to be answered. EDA of the data was showed in Section 4. Section 5 displayed the mediation analysis and Section 6 interpreted moderation analysis result. Finally, the summary and conclusion to our client's three questions were wrapped up in Section 7.

2 Experiment and Methods

2.1 Experiment

Our client set up 9 sessions from 8:00am to 5:00pm. Each session lasts for one hour. The first, fourth and seventh sessions have been chosen as the TV session. People in these three sessions only need to watch the traditional TV. People in the other six sessions need to watch the social TV. Each social TV session would have two chat rooms that have 10 people in expectation. For each chat room, half of the people been assigned to be active and another half people been assigned to be passive. Those who been assigned active need to both watch and chat. Those who been assigned passive only need to be watch and should not chat.

Table 1: Experiment Sessions

Sessions	ExpectedN
Session1	16
Session2	20
Session3	20
Session4	20
Session5	20
Session6	20
Session7	20
Session8	20
Session9	20

Based on the experiment, Our client gathered the original data. The final variables were generated from the experiment data.

There are two independent variables, social TV and real activeness. For social TV variable, people who participated in the TV sessions been coded as 0 for STV, those who participated in social TV group been coded as 1. For real activeness variable, there are four different coding numbers for people in social TV group for different situations. Those who are in the TV group get -1 for this variable. The mediator variable measures people's sense of social connectedness and is the mean of 2 original items.The enjoyment can be classified into two different types, experience enjoyment(mean of 2 original items) and clip enjoyment mean of 5 original items. The final dependent variable is the enjoyment, which is the mean of experience enjoyment and clip enjoyment mean and scale from 1 to 11.

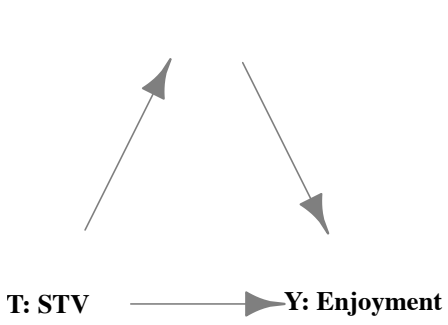
Table 2: Chat Rooms and Engagement

Sessions	ChatRoom	No.	Act.	Pas.
Session2	Chat Room 1	8	5	3
Session2	Chat Room 2	6	3	3
Session3	Chat Room 3	8	4	4
Session3	Chat Room 4	8	4	4
Session5	Chat Room 5	8	5	3
Session5	Chat Room 6	7	5	2
Session6	Chat Room 7	8	6	2
Session6	Chat Room 8	8	4	4
Session8	Chat Room 9	9	6	3
Session8	Chat Room 10	10	7	3
Session9	Chat Room 11	9	4	5
Session9	Chat Room 12	8	7	1

2.2 Methods

2.2.1 Mediation Analysis

The frame work of Mediation Analysis consist of 3 part:



1. The overall all relationship between Independent variable(T) and Dependent variable(Y)

$$Y = \alpha_1 + \beta_1 T + \xi_1^T X + \epsilon_1$$

2. The relationship between Independent variable(T) and Mediator(M)

$$M = \alpha_2 + \beta_2 T + \xi_2^T X + \epsilon_2$$

3. The relationship between Independent varaible(T), Mediator(M) and Dependent variable(Y)

$$Y = \alpha_3 + \gamma M + \beta_3 T + \xi_3^T X + \epsilon_3$$

*X are other variables that affect the dependent variable.

Our indices of interest are:

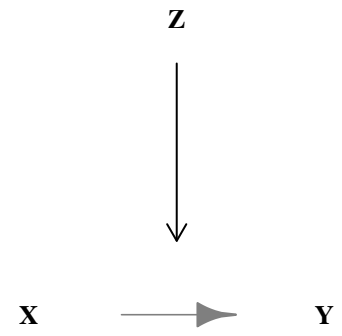
Average Causal Mediation Effect(ACME): $\delta = \gamma\beta_2$

Average Direct Effect(ADE): $\zeta = \beta_3$

Total Effect: $\tau = \beta_1$

2.2.2 Moderation Analysis

Moderation occurs when the effect the Independent variable(X) on the dependent variable(Y) depends on the moderator(Z):



$$Y = \beta_0 + \beta_1 X + \beta_2 Z + \beta_3 XZ + \epsilon_y$$

Our index of interest is the effect of moderator on the effect of Independent variable: β_3

3 Research Question

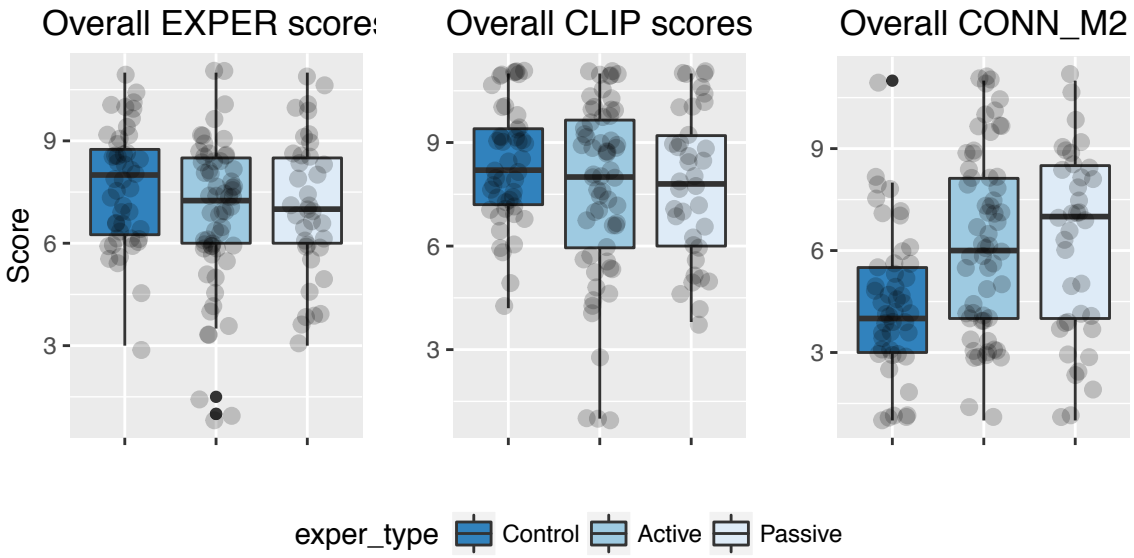
Based on our conversations, client is interested in

1. Whether participating in STV will help to increase the enjoyment?
2. Does connectedness mediate participating in STV and enjoyment?
3. Whether the type of engagement (activeness/passiveness) will moderate the relationship between participating in STV and connectedness?

4 EDA

4.1 EDA for Total Data

The result of two types of enjoyment and connectedness is plotted for control group and two types of treatment group.



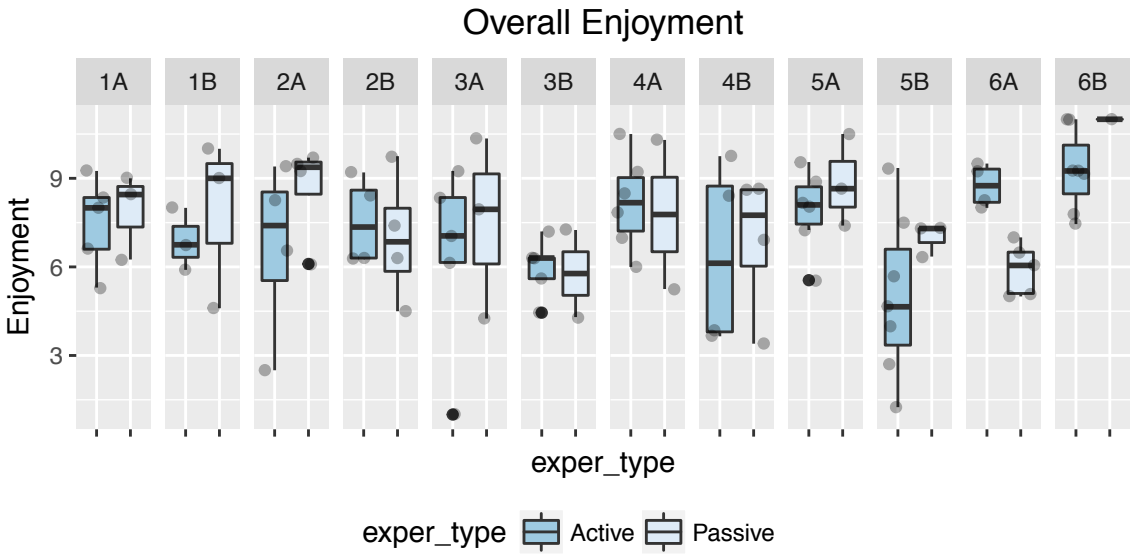
From the boxplot:

1. The enjoyment score(Both EXPER score and CLIP score) of control group is slightly higher than the active and passive group.
2. There is almost no different on enjoyment scores between the active and passive group.
3. The active group and passive have higher connectedness score than the control group.

4.2 EDA for Each Room Data

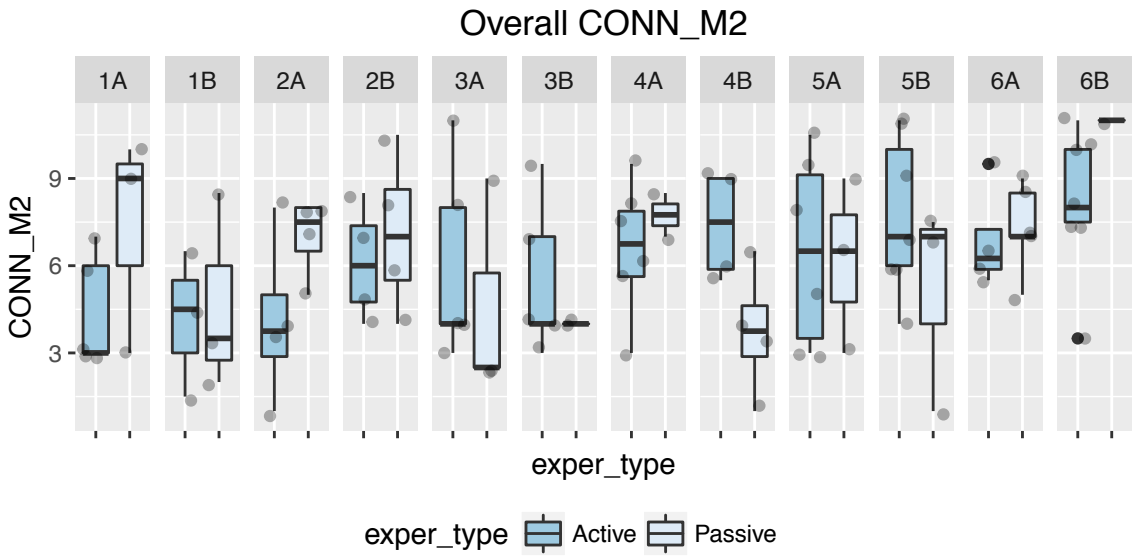
Because people in different session are assigned different chatroom. We suspect if chatroom have an effect on the enjoyment and connectedness.

Enjoyment over different Room and different activeness is plotted.



We can see that the result in different room varies a lot. For example, in chatroom 2A, passive group have higher enjoyment than active group while in chatroom 6A, it is active group that have higher enjoyment.

Connectedness over different Room and different activeness is plotted as well.



We can see that chat room again have impact on connectedness. For example, in chatroom 2A, the passive group have higher connectedness while in chatroom 4B the active group have higher connectedness.

Based on the exploratory data analysis. We believe that it is necessary to include chatroom effect in the mediation and moderation analysis.

5 Mediation Analysis

In this project, we used linear mixed effect models to check the relationship between participating in social TV and enjoyment. Then check the relationship between participating in social TV and mediator(connectedness). Finally, we checked enjoyment's relationship with independent variable and mediator(connectedness) together. We also used `mediation (Tingley, Yamamoto, Hirose, Keele, & Imai, 2014)` r package to conduct a Hypothesis test of whether the indices is equal to 0 and produced 95% Confidence interval.

In the model, we added the room effect as the random effect and used mixed effect model. The reason for that was because through our EDA we saw that different chat room may have a different impact on the result of enjoyment and within a chat room we expect there to be correlations in their experiences. Since all people in one chat room would be influenced by what was posted on the screen.

```
lmer4 = lmer(data = raw, Enjoyment ~ `T` + (1|ChatRoomName))
lmer5 = lmer(data = raw, CONN_M2 ~  `T` + (1|ChatRoomName))
lmer6 = lmer(data = raw, Enjoyment ~ `T` + CONN_M2 + (1|ChatRoomName))

med1 = mediate(model.m = lmer5, model.y = lmer6,
               treat = "T", mediator = "CONN_M2")
summary(med1)
```

```
##
## Causal Mediation Analysis
##
## Quasi-Bayesian Confidence Intervals
##
## Mediator Groups: ChatRoomName
##
## Outcome Groups: ChatRoomName
##
```

```
## Output Based on Overall Averages Across Groups
##
##                Estimate 95% CI Lower 95% CI Upper p-value
## ACME             0.4530       0.0429       0.9852    0.03
## ADE             -1.1253      -2.7608       0.5022    0.17
## Total Effect    -0.6723      -2.3723       0.8996    0.45
## Prop. Mediated  -0.3289      -6.3434       8.2923    0.48
##
## Sample Size Used: 144
##
##
## Simulations: 1000
```

The result shows that the average causal mediation effect(ACME) on Enjoyment of participate in Social TV is 0.46. However, statistically, we can not get significant conclusion about the direct effect of STV on Enjoyment and, correspondingly, total effect of STV on Enjoyment.

6 Moderation Analysis

In this project, we used the linear mixed effect model to check the interaction of participating in social TV and moderator(activeness) when we check these two variables' relationship with mediator(connectedness).

Still, we use mixed effect model to include chatroom effect. Notice that our moderator only make sense when people participating in STV is true. Thus, we only have $Y = \beta_0 + \beta_1 X + \beta_3 XZ + e_y$

```
raw$active = ifelse(raw$exper_type == "Active",yes = "Active",no = "Passive")
raw$active = factor(raw$active,levels = c("Passive","Active"))
tmp2 = lmer(data = raw, CONN_M2 ~ `T` + `T`:active + (1|ChatRoomName))
summary(tmp2)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: CONN_M2 ~ T + T:active + (1 | ChatRoomName)
##    Data: raw
##
## REML criterion at convergence: 672.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.18417 -0.77351  0.00172  0.78378  2.63472
##
## Random effects:
##  Groups       Name        Variance Std.Dev.
##  ChatRoomName (Intercept) 0.3874   0.6224
##  Residual                 6.1663   2.4832
## Number of obs: 144, groups:  ChatRoomName, 13
##
## Fixed effects:
##                Estimate Std. Error t value
## (Intercept)      4.4574     0.7202   6.189
## T                1.6922     0.8486   1.994
## T:activeActive   0.1285     0.5249   0.245
##
## Correlation of Fixed Effects:
##             (Intr) T
```

```
## T           -0.849
## T:activActv  0.000 -0.382
```

Because activeness only make sense for people who watch STV, we fit a mixed effect model with `activeness` only in interaction.

The result shows that the interaction between STV and Activeness is not significant, we lack evidence to say there is impact of Activeness for people who watch social TV

7 Conclusion

Through EDA, we've identified there maybe effect of chat room that affect the score of enjoyment and connectedness: In some chat room the score of control group is higher than social TV group; while in some chat room the situation is opposite.

Thus, it is necessary to involve chat room effect in our analysis. Due to the nested data issue, we used mixed effect model to build the mediation analysis. From the analysis, we could answer our client's questions:

1. Participating in STV will not help to increase the enjoyment. Because the `Total effect` of Social TV on Enjoyment is -0.68, which is to say participating in STV will decrease the enjoyment. However, this conclusion is not solid for the p-value of Total effect is 0.41, means that we can not say the total effect is significantly different from 0.
2. The mediator, connectedness, mediate participating in STV and enjoyment. What's more, we are confidence to say that the paticipating in STV have a positive impact on enjoyment through the mediation of connectedness because the ACME is 0.45 with p value = 0.02.
3. The type of engagement (activeness/passiveness) will not moderate the relationship between participating in STV and connectedness. Because the coefficient of interaction term in moderation analysis is not significantly different from 0.