AHP

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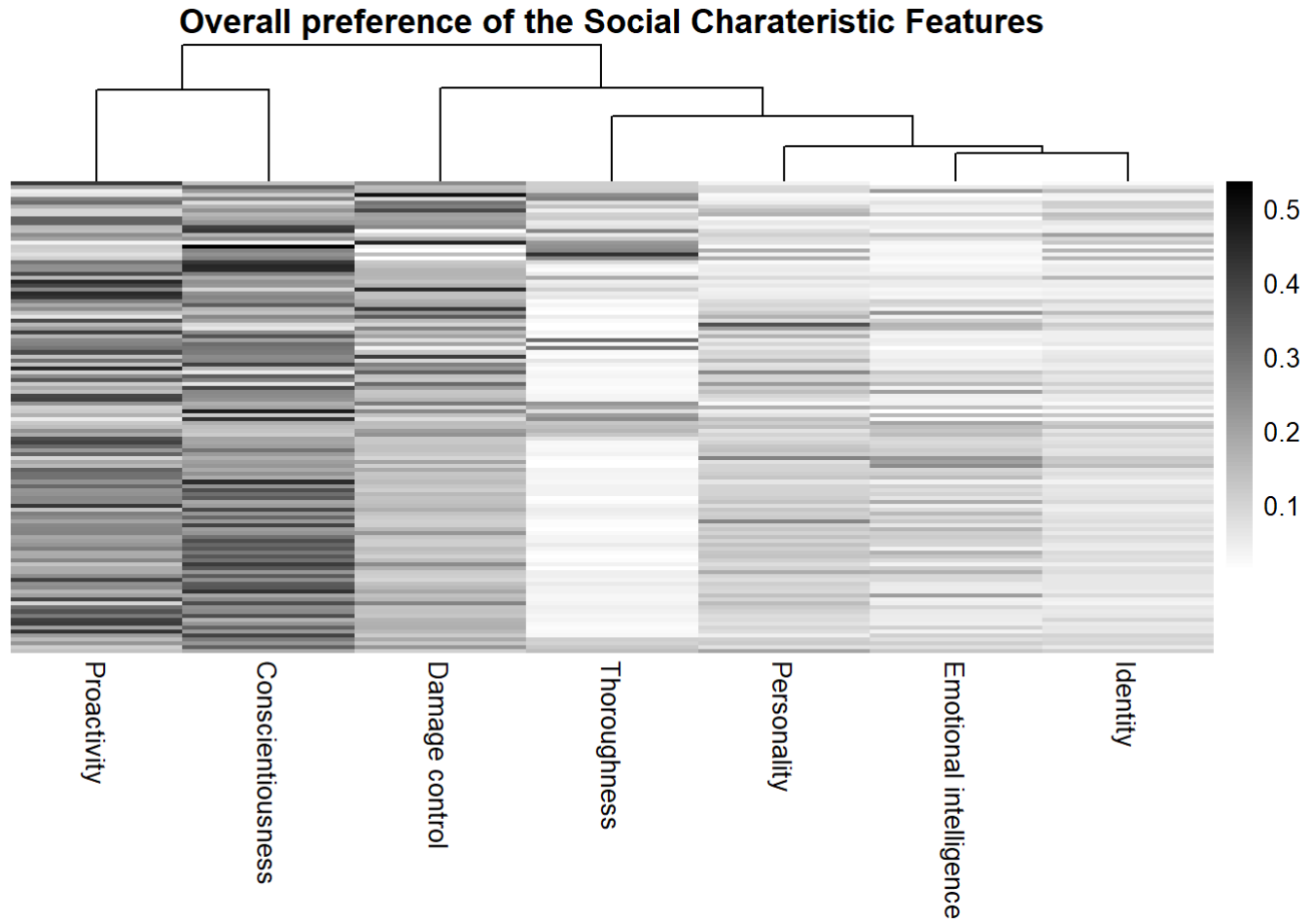
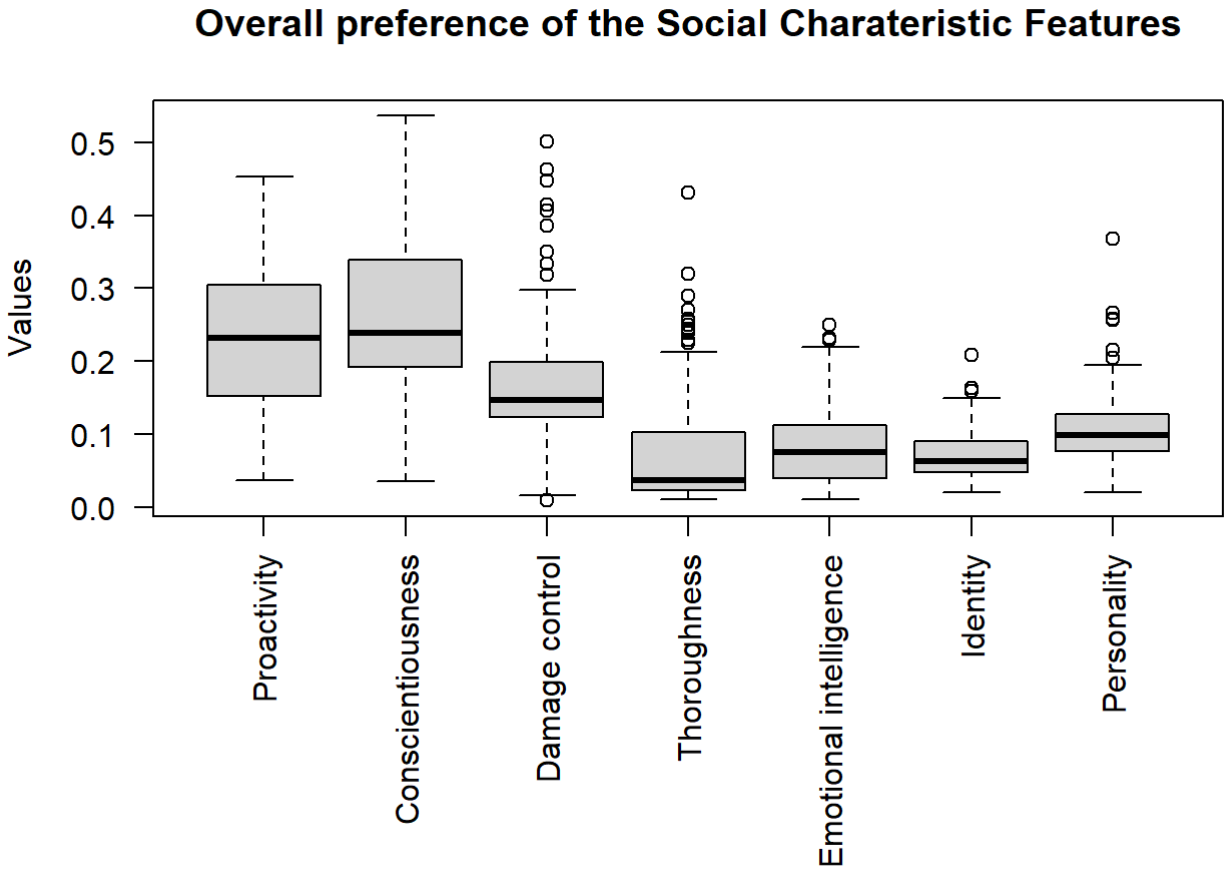
Understanding User Preferences for social characteristics Features in IBM SkillsBuild Chatbot: Analysis using the Analytic Hierarchy Process (AHP)

```
library(ahpsurvey)
library(magrittr)
library(pheatmap)

atts = c(
    'Proactivity', 'Conscientiousness', 'Damage control',
    'Thoroughness', 'Emotional intelligence', 'Identity',
    'Personality'
)

df = read.csv('C:/Users/louyu/D_AHP/extents.csv')
user_profiles = read.csv('C:/Users/louyu/D_AHP/user_profiles.csv')
```

```
# AHP on every single row

data_ahp = df %>%
    ahp.mat(atts = atts, reciprocal = TRUE) # Converting negative numbers to reciprocal

eigentrue = ahp.indpref(data_ahp, atts, method = "eigen")

# Compute pairwise comparison matrices
data_matrix <- as.matrix(eigentrue)

pheatmap(data_matrix,
         cluster_rows = FALSE,   # Set to TRUE if you want to cluster rows
         cluster_cols = TRUE,   # Set to TRUE if you want to cluster columns
         color = colorRampPalette(c("white", "black"))(100),
         main = "Overall preference of the Social Charateristic Features")
```




```
# Create the box plot
par(mar = c(10, 5, 4, 2) + 0.1)
boxplot(data_matrix,
        main = "Overall preference of the Social Charateristic Features",
        ylab = "Values",
        las = 2)
```


Overall preference of the Social Charateristic Features
Values
0.0
0.1
0.2
0.3
0.4
0.5
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

```
split_dataframe_by_column <- function(data_frame, user_prof, column_name) {
  # Get unique values of the specified column
  unique_values <- unique(user_prof[[column_name]])

  # Create an empty list to store the subsets
  dataframes_list <- list()

  # Split the data frame by the specified column and store subsets in the list
  for (value in unique_values) {
    indices = which(user_prof[[column_name]] == value)
    subset_df = data_frame[indices, ]
    dataframes_list[[as.character(value)]] <- subset_df
  }

  return(dataframes_list)
}
plot_heat_map = function(data_frame, user_profiles, column_name, column_full_name) {
  df_list = split_dataframe_by_column(data_frame, user_profiles, column_name)
  column_names = names(df_list)
  agg_ahps = c()

  for (value in column_names) {
    ahp_value = df_list[[value]] %>%
      ahp.mat(atts = atts, reciprocal = TRUE)

    eigentrue = ahp.indpref(ahp_value, atts, method = "eigen")
    agg = ahp.aggpref(ahp_value, atts, method = "eigen")

    data_matrix <- as.matrix(eigentrue)
    agg_ahps = rbind(agg_ahps, agg)

    if (nrow(eigentrue) == 1 & all(eigentrue[1, ] == eigentrue[1, 1])) {
      cat(paste("WARNING: there is only one rows of", value, "in",
                column_full_name,
                "\nand all columns have the same value.",
                "\nThe heatmap is omitted due to R will output error in this case.",
                "\nBut this row will show up in the",
                paste("\nPreferred Social Charateristic Features of different", column_full
_name)))
      next
    }

    full_name_with_brakets = paste0("(", column_full_name, ")")
    pheatmap(data_matrix,
             cluster_rows = FALSE,   # Set to TRUE if you want to cluster rows
             cluster_cols = FALSE,   # Set to TRUE if you want to cluster columns
             color = colorRampPalette(c("white", "black"))(100),
             main = paste("Preferred Social Charateristic Features of different", value, full
_name_with_brakets))

  }

  rownames(agg_ahps) <- column_names
  data_matrix <- as.matrix(agg_ahps)
  pheatmap(data_matrix,
```

```
            cluster_rows = FALSE,   # Set to TRUE if you want to cluster rows
            cluster_cols = FALSE,   # Set to TRUE if you want to cluster columns
            color = colorRampPalette(c("white", "black"))(100),
            main = paste("Preferred Social Charateristic Features of different", column_full_n
ame))
}
plot_box_plot = function(data_frame, user_profiles, column_name, column_full_name) {
  df_list = split_dataframe_by_column(data_frame, user_profiles, column_name)
  column_names = names(df_list)
  all_values = c()  # Create a vector to store all data points
  group_labels = c()  # Create a vector to store group labels

  for (value in column_names) {
    ahp_value = df_list[[value]] %>%
      ahp.mat(atts = atts, reciprocal = TRUE)

    eigentrue = ahp.indpref(ahp_value, atts, method = "eigen")

    data_vector <- as.vector(eigentrue)
    all_values = c(all_values, data_vector)  # Concatenate data vectors
    group_labels = c(group_labels, rep(value, length(data_vector)))
  }

  # Get the number of boxplots to be plotted
  num_plots <- length(column_names)

  # Create a vector of colors for the boxplots
  boxplot_colors <- rainbow(num_plots)

  par(mar = c(9, 5, 4, 2) + 0.1)
  # Create the boxplot with all data points
  boxplot(all_values,
          col = rep(boxplot_colors, each = ncol(eigentrue)),
          at = 1:(num_plots * ncol(eigentrue)),
          main = paste("Preferred Social Charateristic Features of different", column_full_na
me),
          ylab = "Values",
          # xlab = rep(names(eigentrue), each = num_plots),
          las = 2)

  # Add group labels to the x-axis
  # xis(side = 1, at =  1:(num_plots * ncol(eigentrue)),
  #     labels = rep(names(eigentrue), each = num_plots), las = 2)

  # Create the legend
  par(xpd = TRUE)
  legend("topright", legend = column_names, fill = boxplot_colors, bty = "n", inset = c(0,
0))

}
```

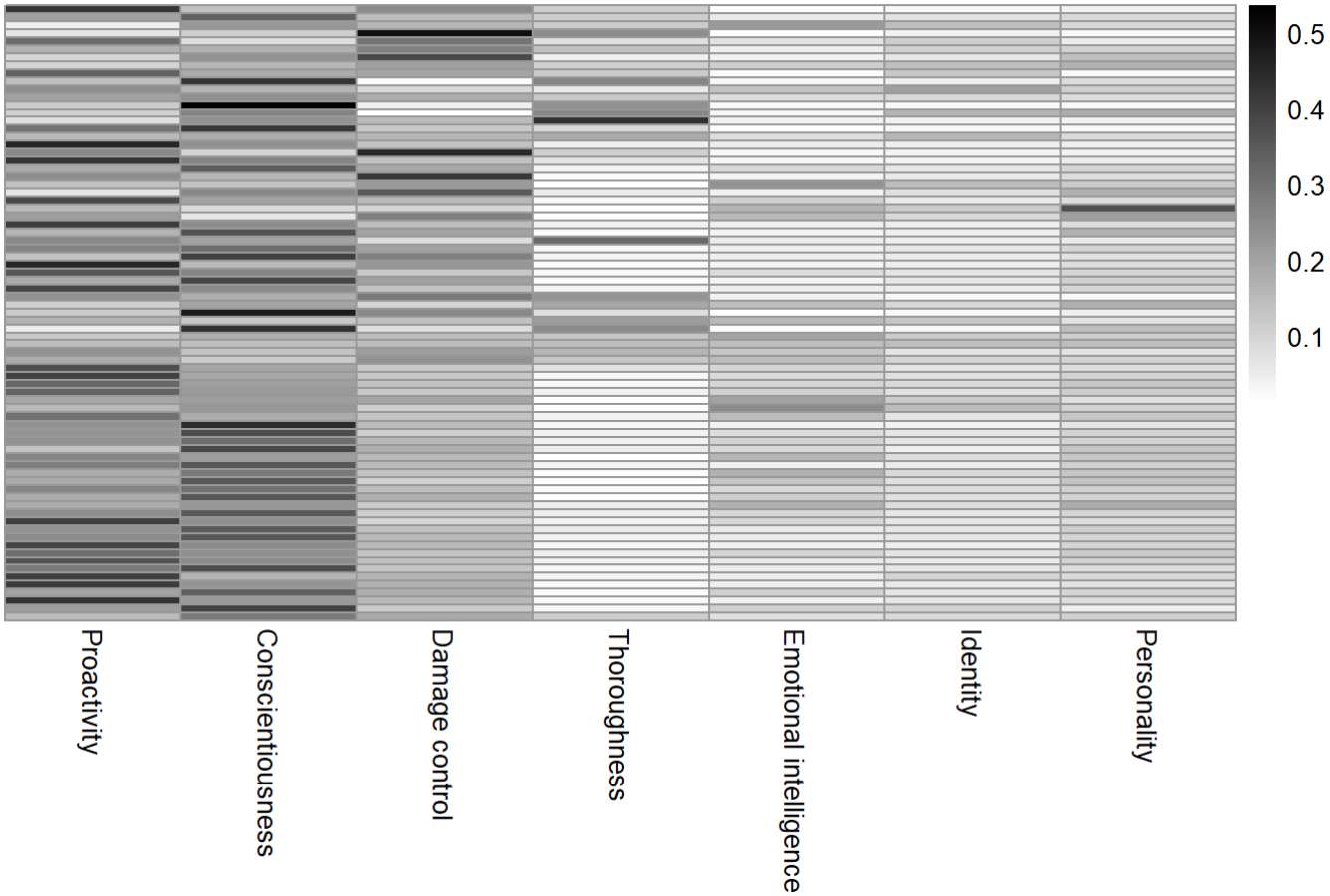
AHP on Whether interacted with IBM Chatbot

AHP on Whether interacted with IBM SkillsBuild Chatbot is omitted since all participants answered yes.

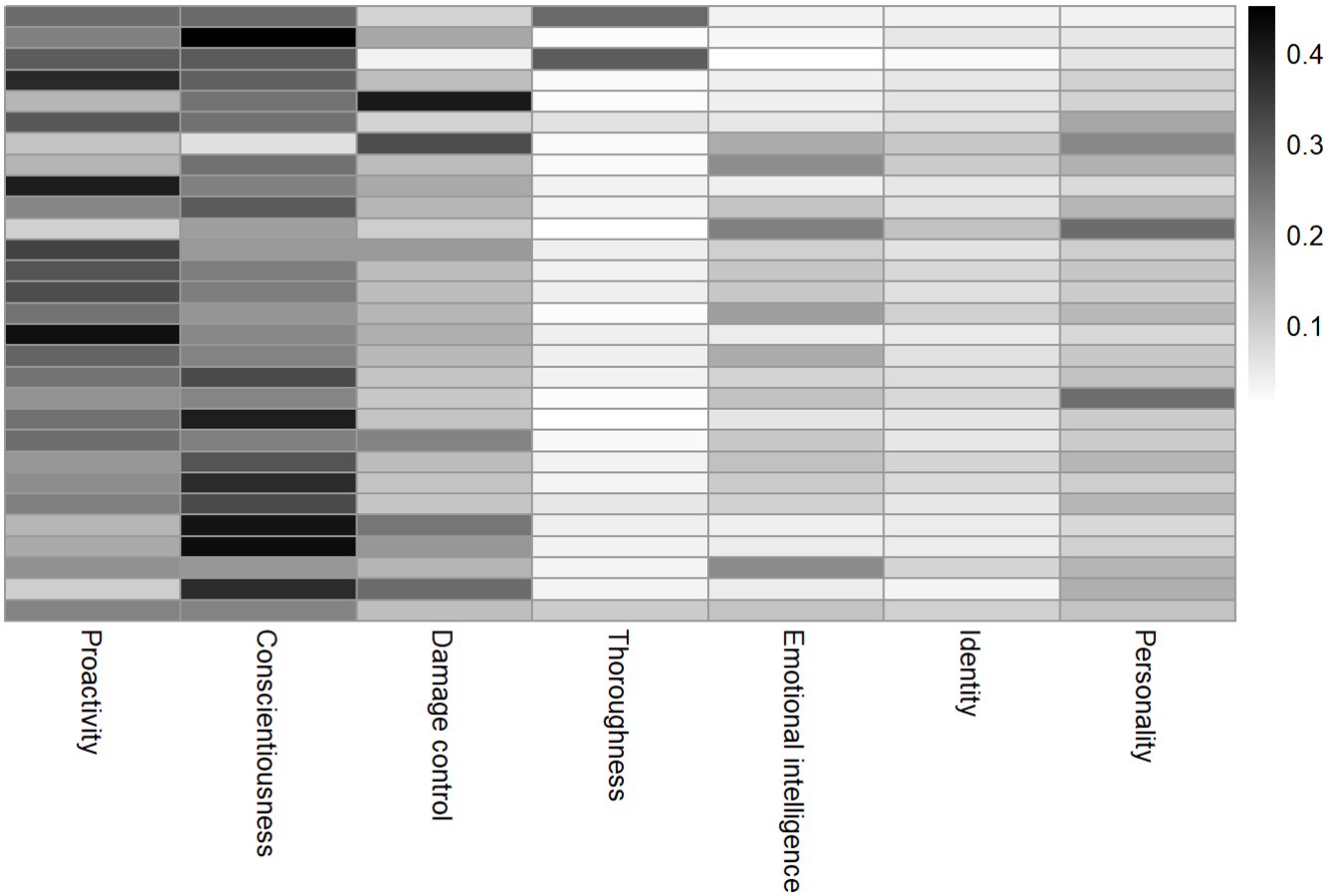
AHP on age

```
plot_heat_map(df, user_profiles, "age", "age")
```

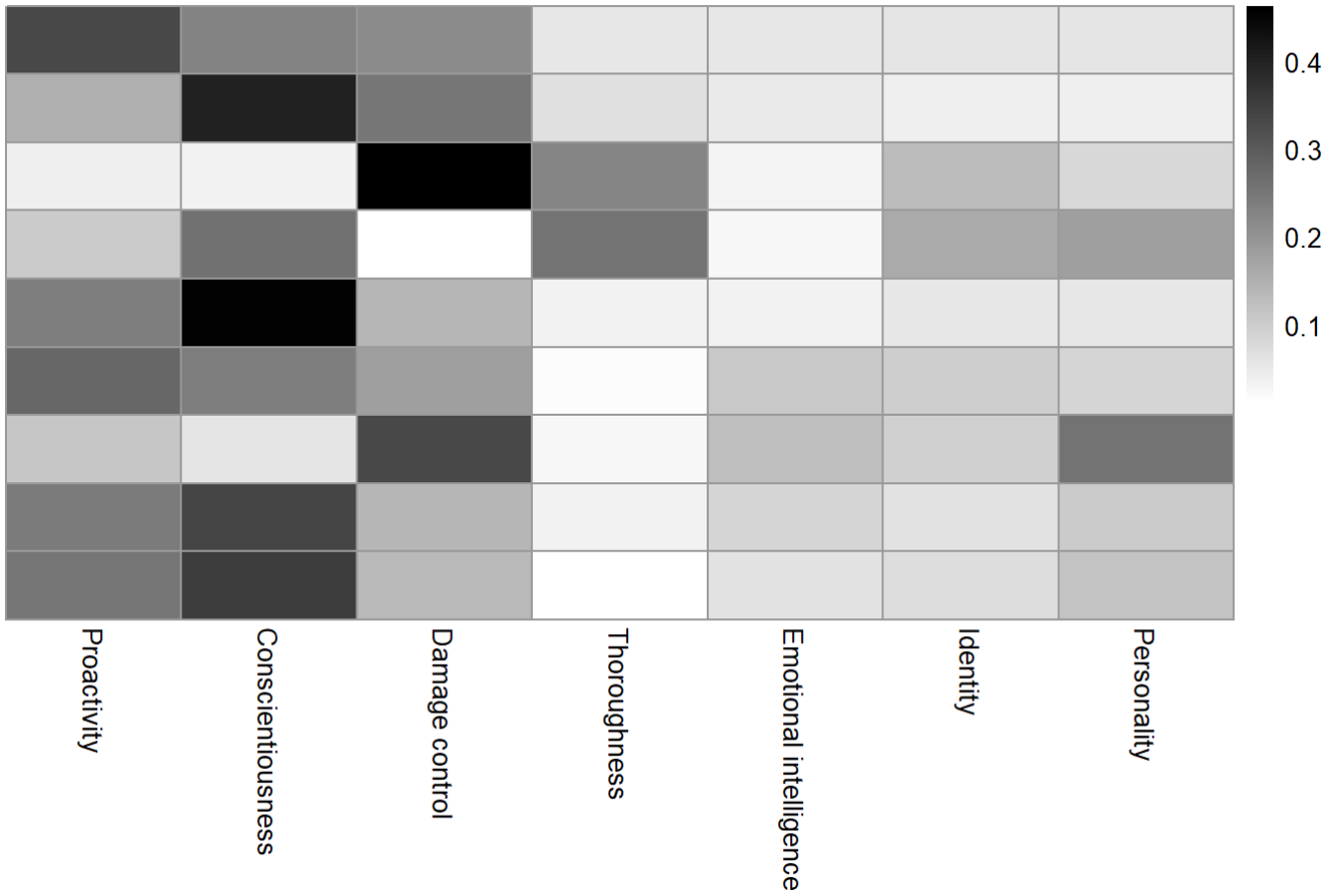
Preferred Social Charateristic Features of different 18 - 24 years old (age)



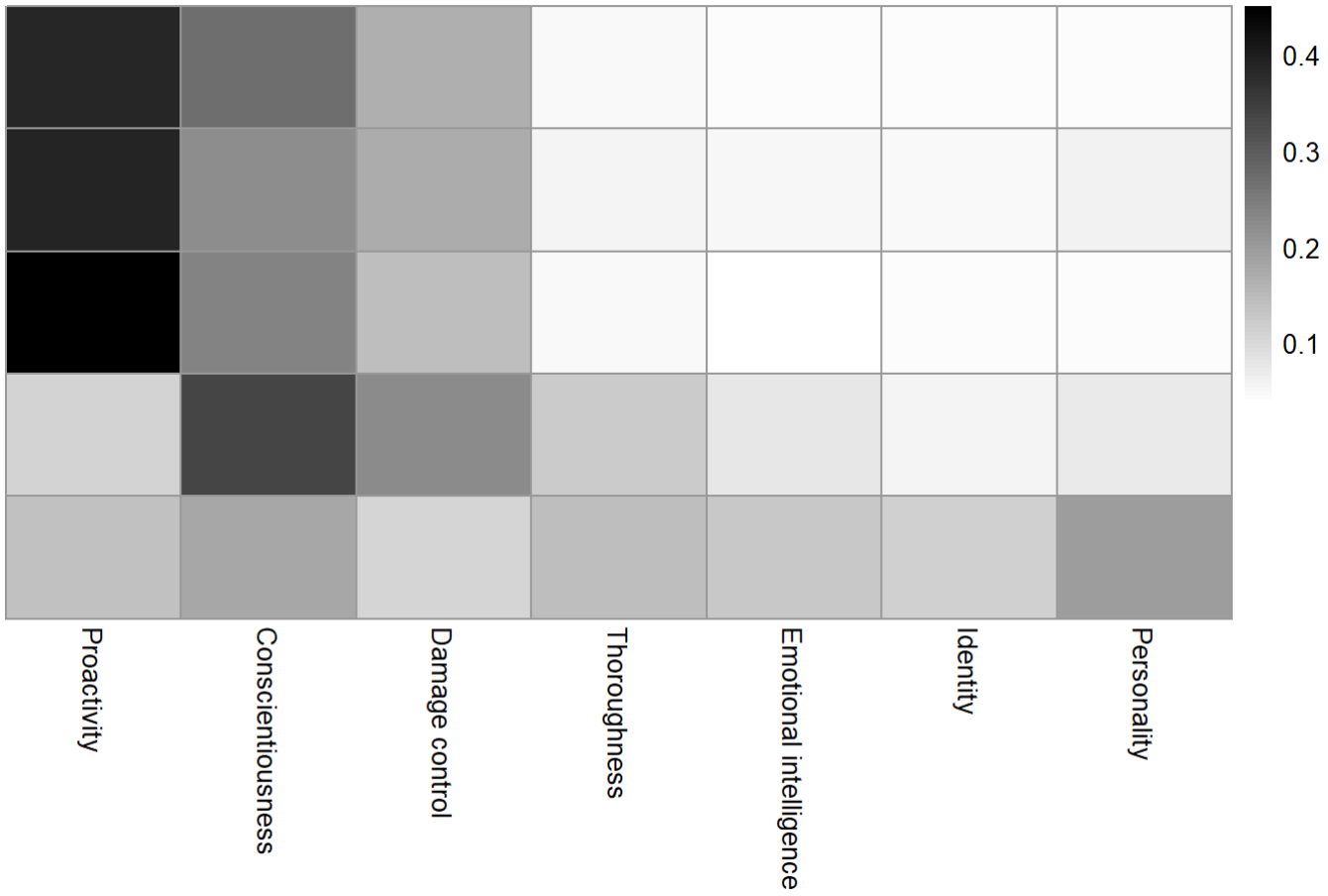
Preferred Social Charateristic Features of different 25-34 years old (age)

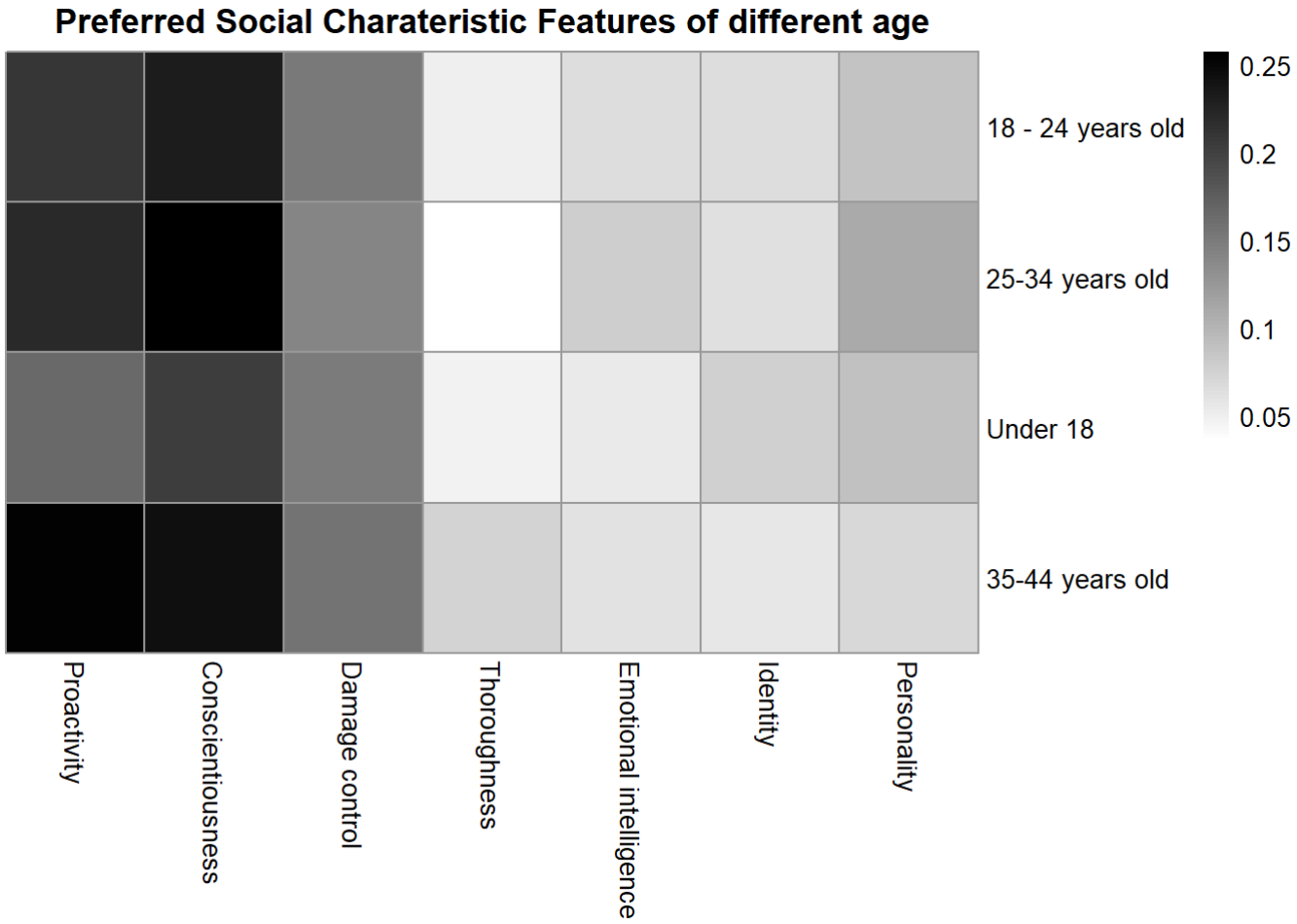


Preferred Social Charateristic Features of different Under 18 (age)

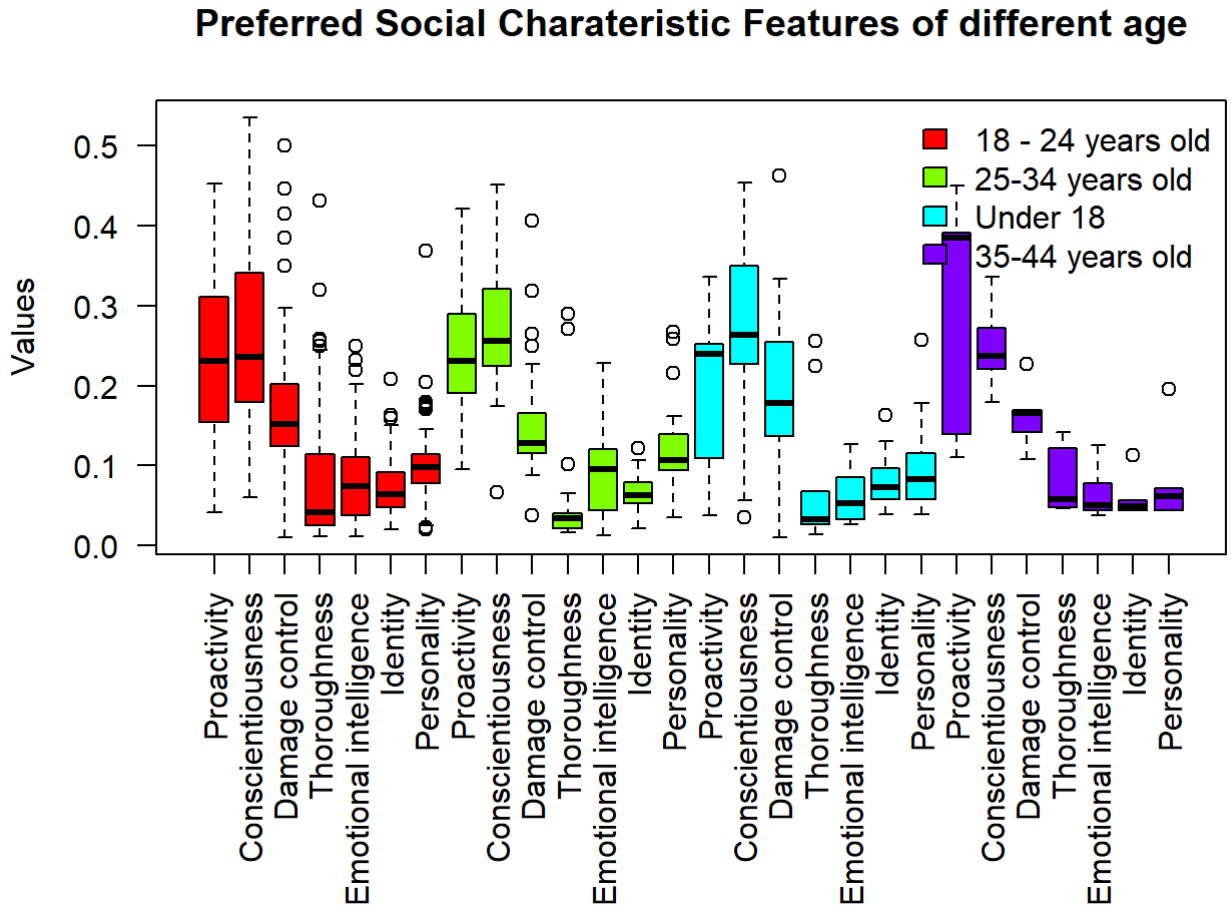


Preferred Social Charateristic Features of different 35-44 years old (age)





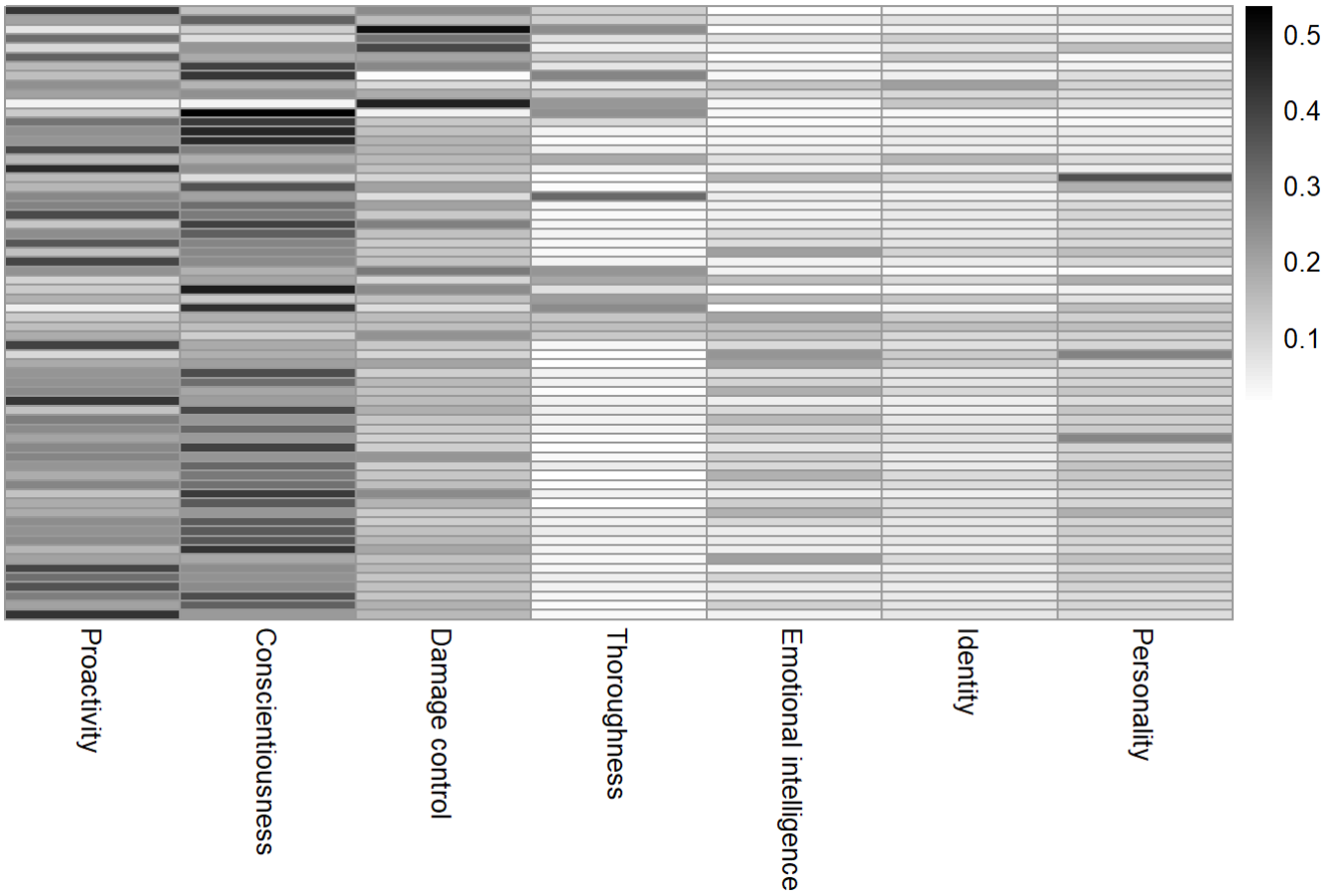

```
plot_box_plot(df, user_profiles, "age", "age")
```



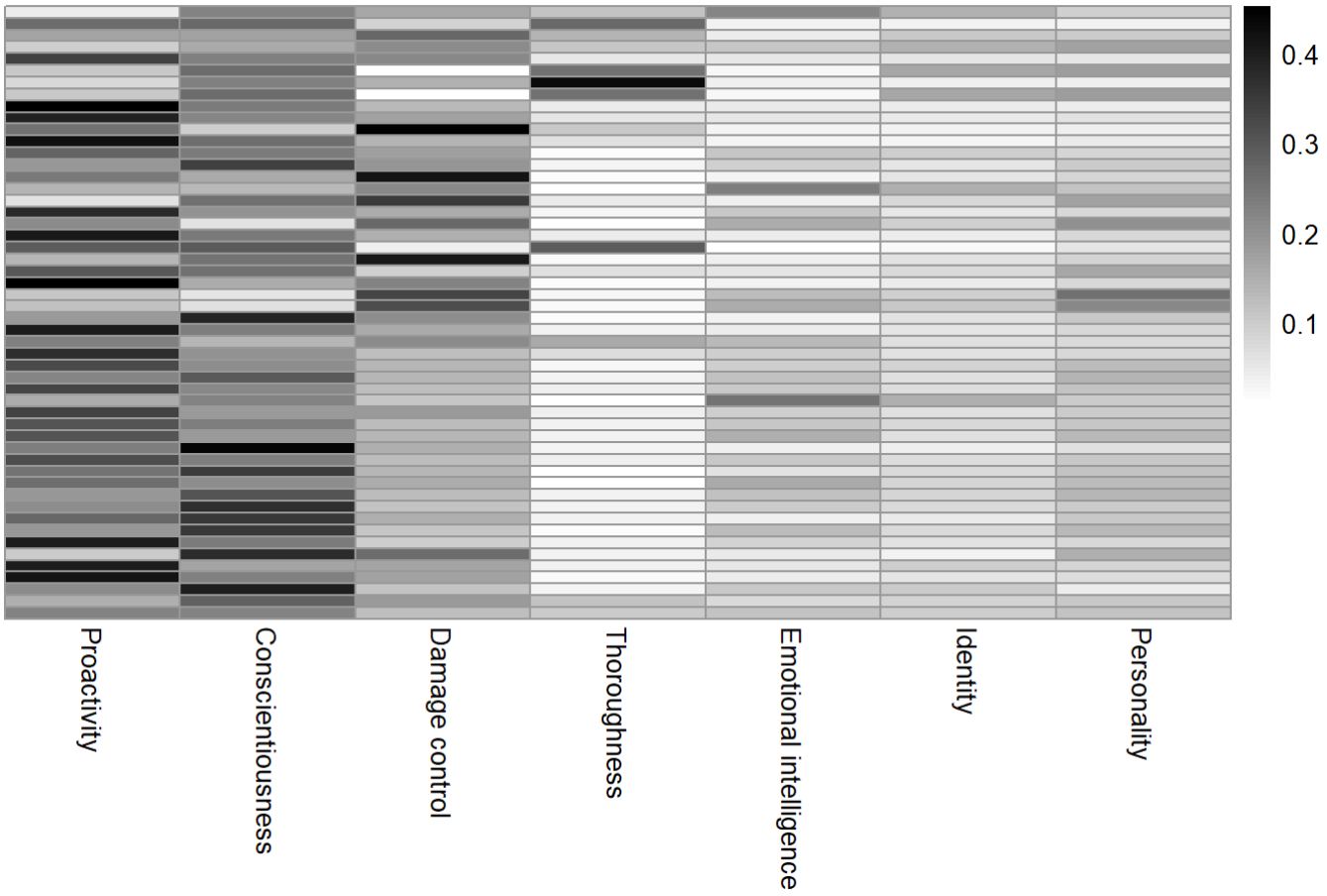
AHP on gender

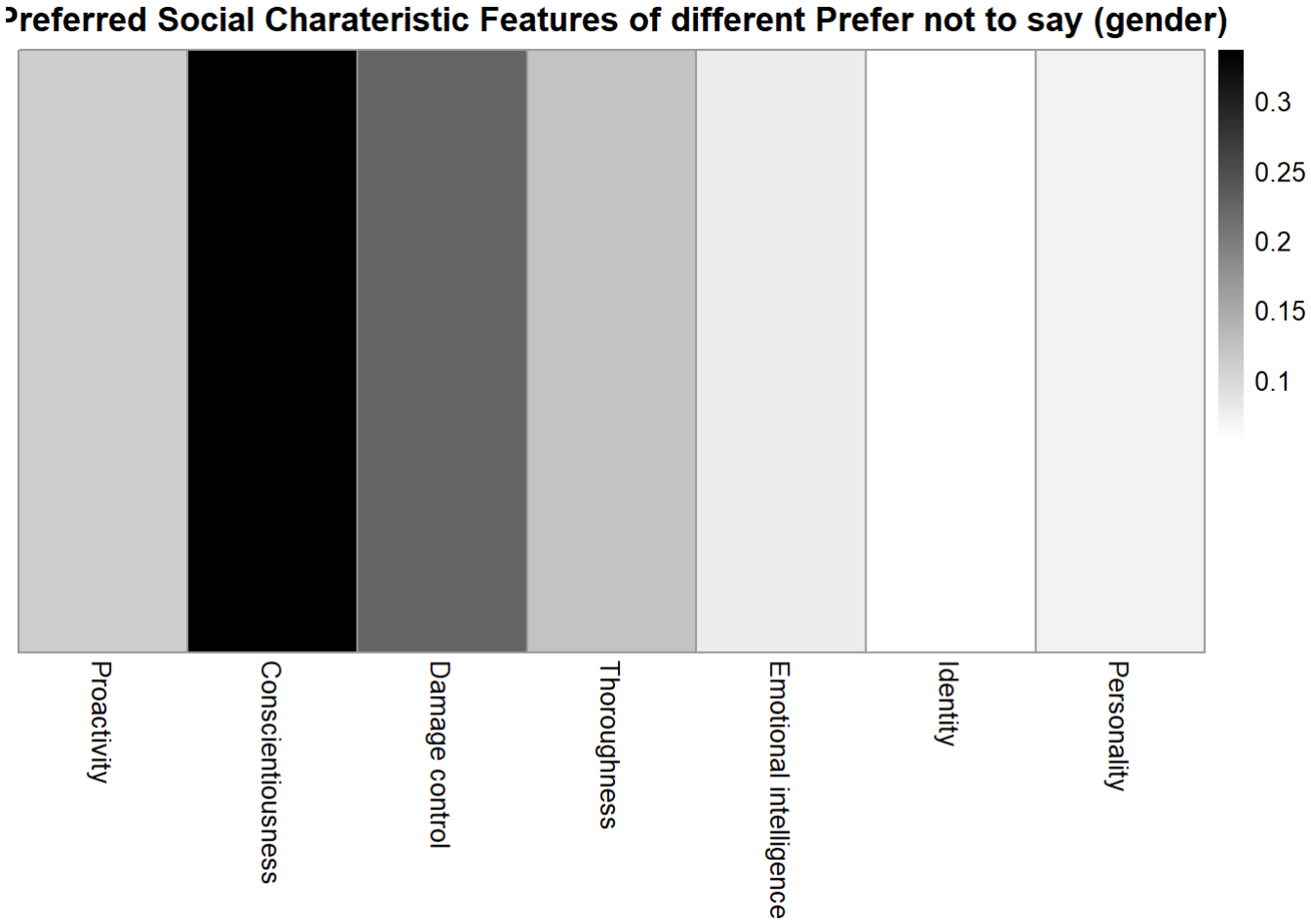
```
plot_heat_map(df, user_profiles, "gender", "gender")
```

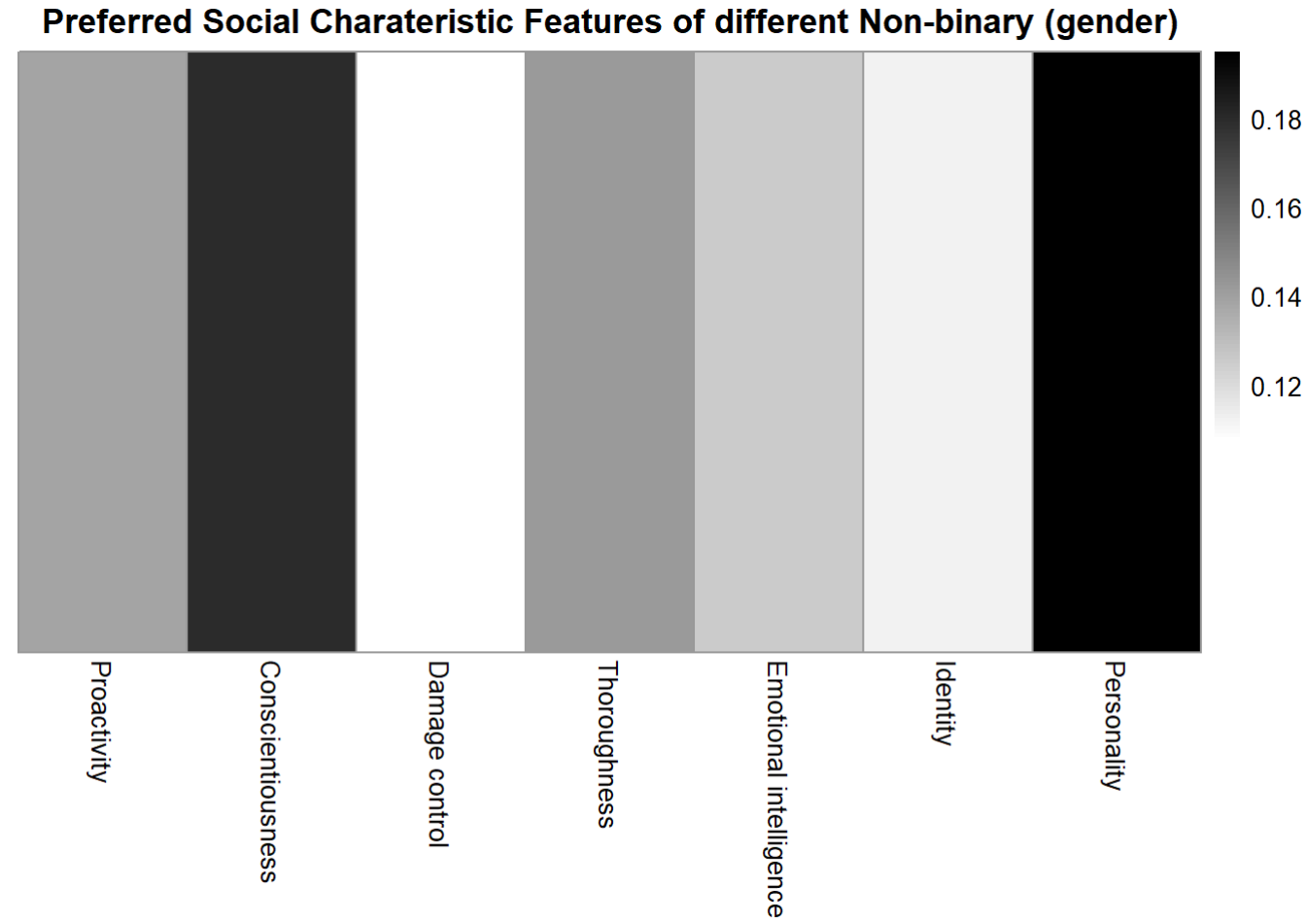
Preferred Social Charateristic Features of different Female (gender)

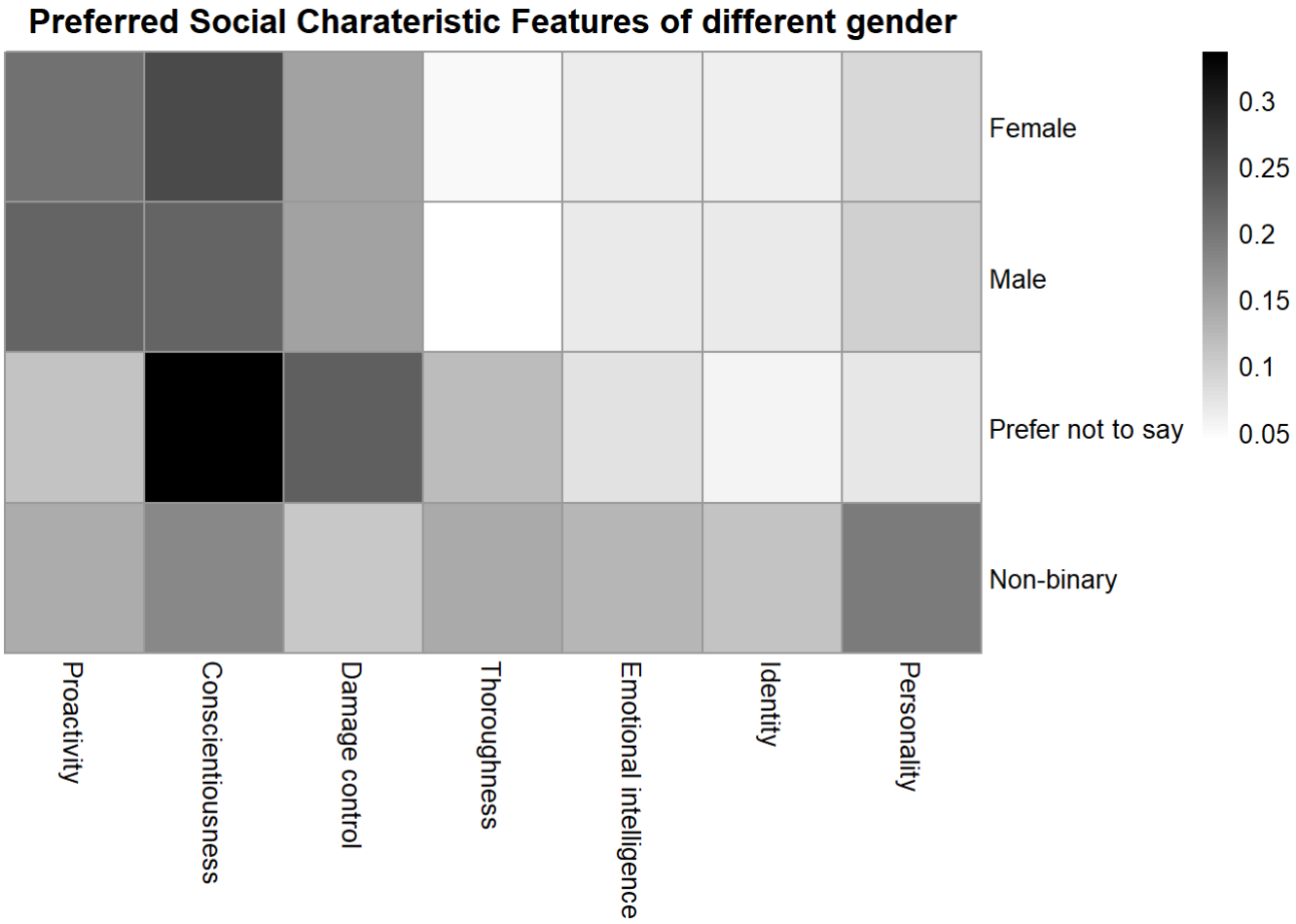


Preferred Social Charateristic Features of different Male (gender)

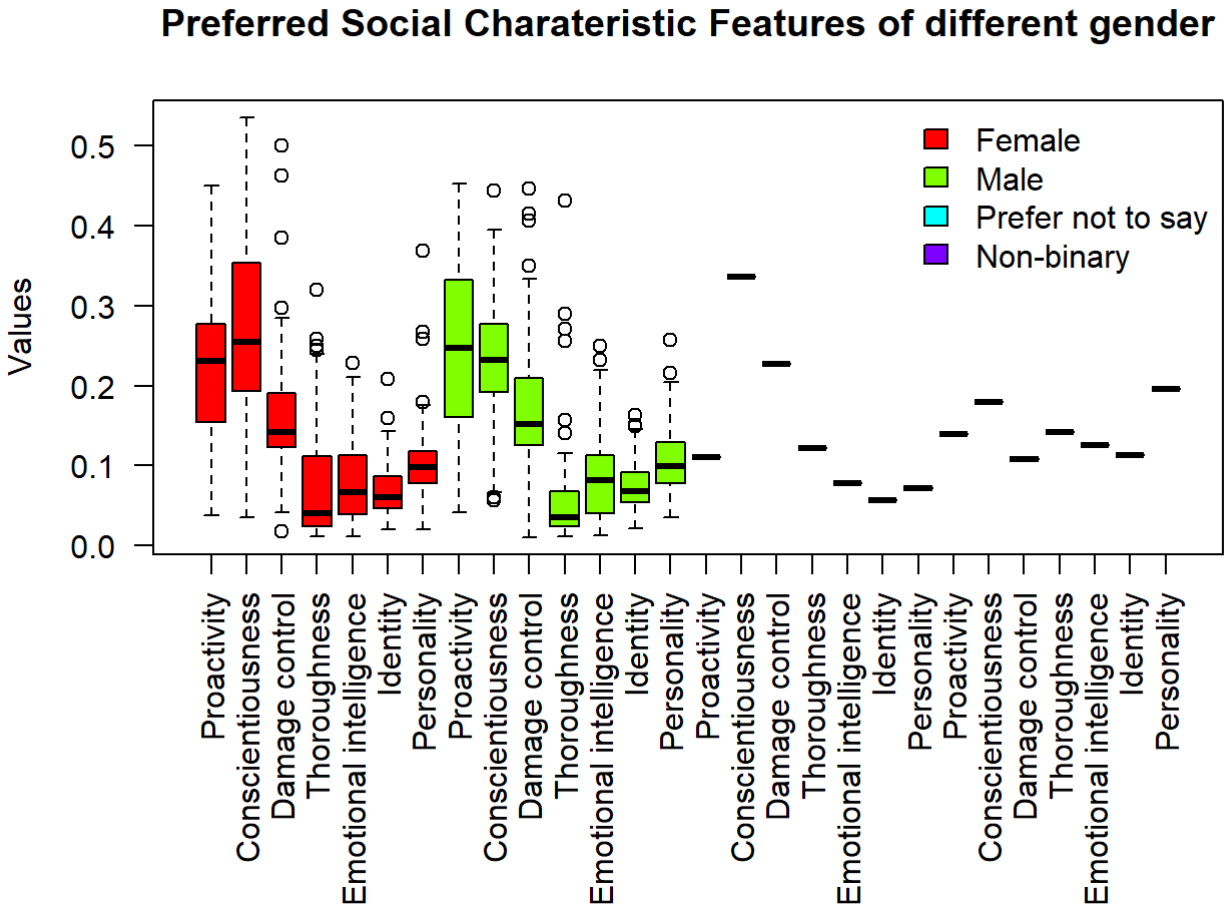



Preferred Social Charateristic Features of different Prefer not to say (gender)
0.3
0.25
0.2
0.15
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality


Preferred Social Charateristic Features of different Non-binary (gender)
0.18
0.16
0.14
0.12
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

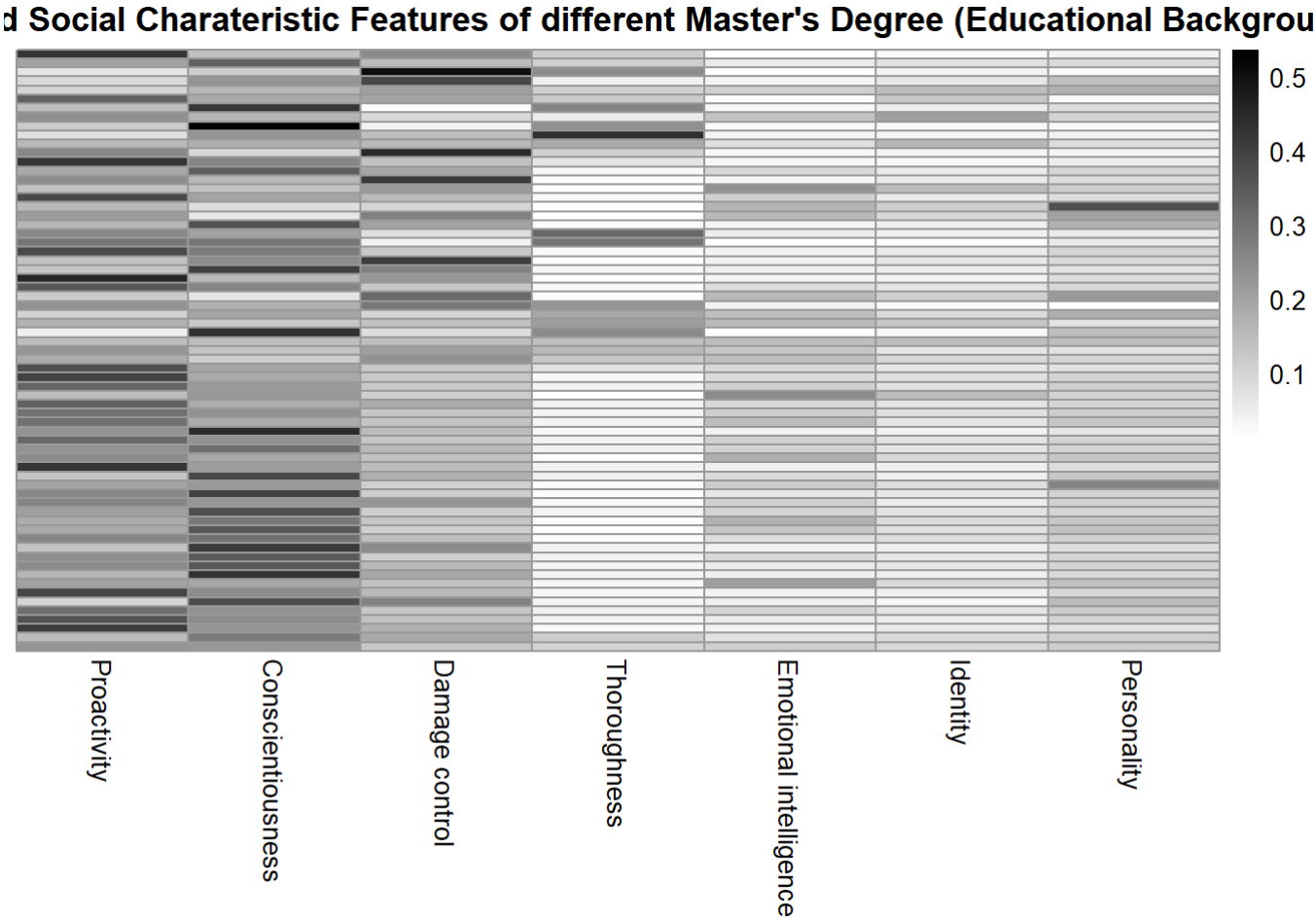


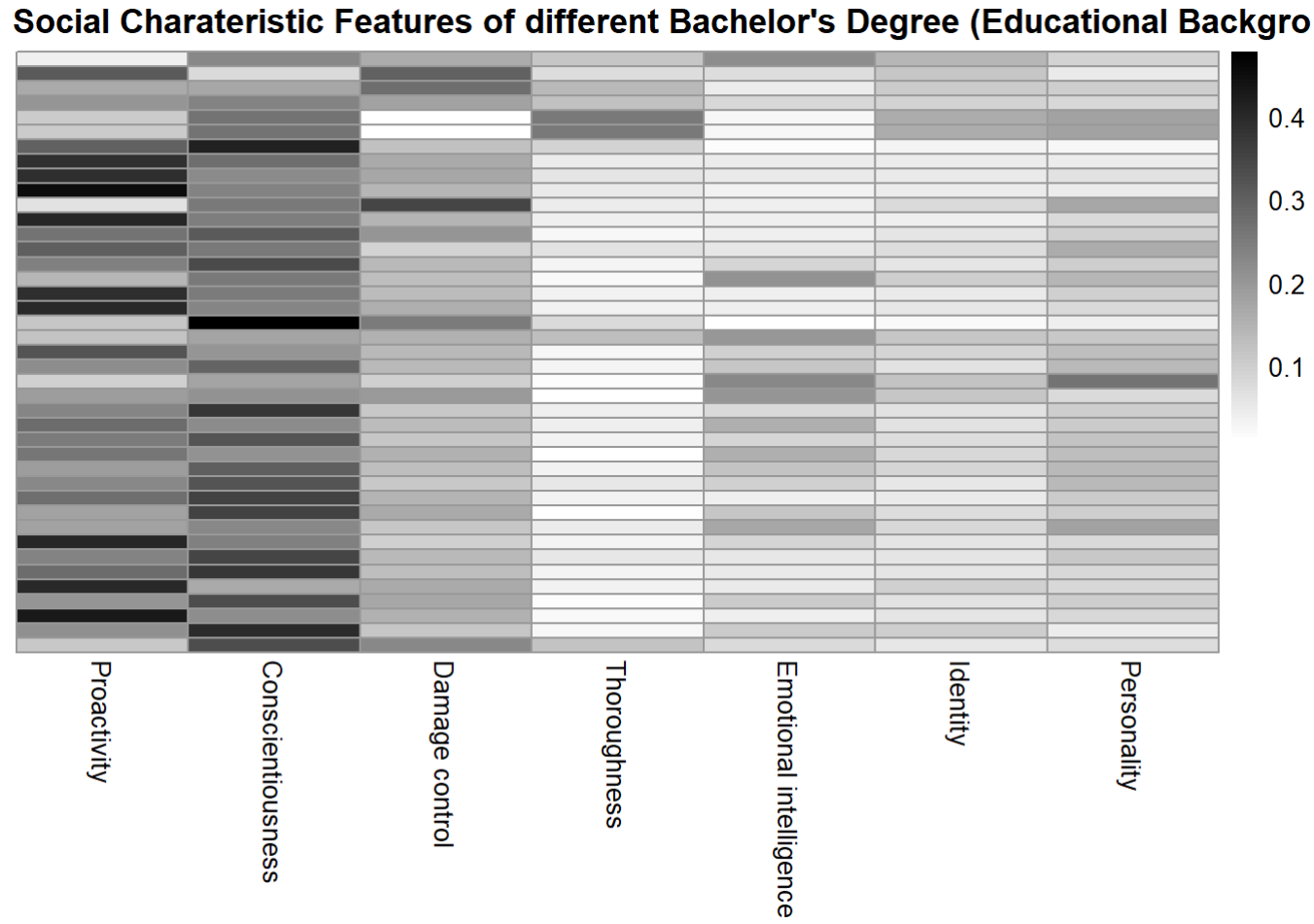

```
plot_box_plot(df, user_profiles, "gender", "gender")
```



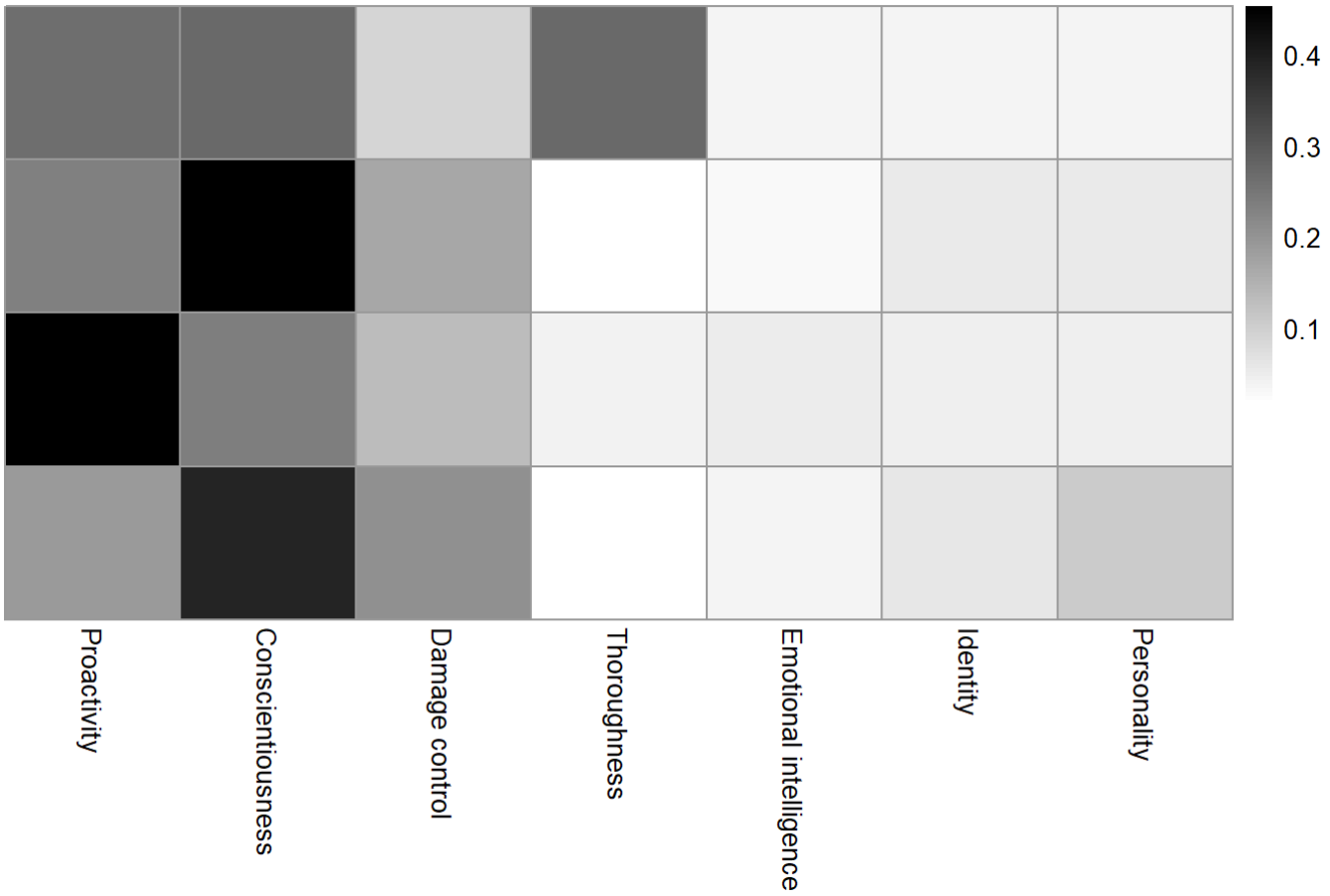
AHP on Educational Background

```
plot_heat_map(df, user_profiles, "edu", "Educational Background")
```

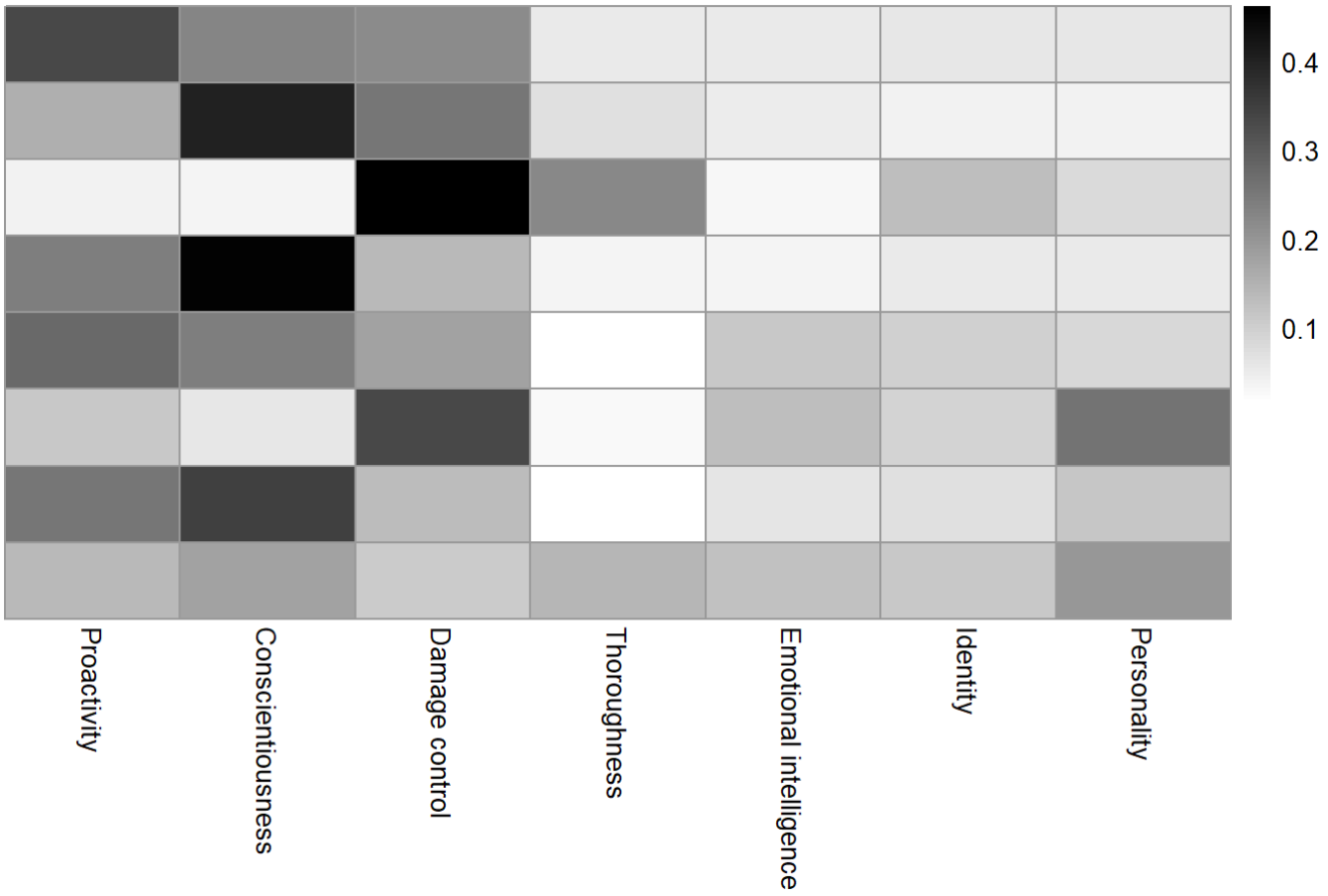

d Social Charateristic Features of different Master's Degree (Educational Backgrou
0.5
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

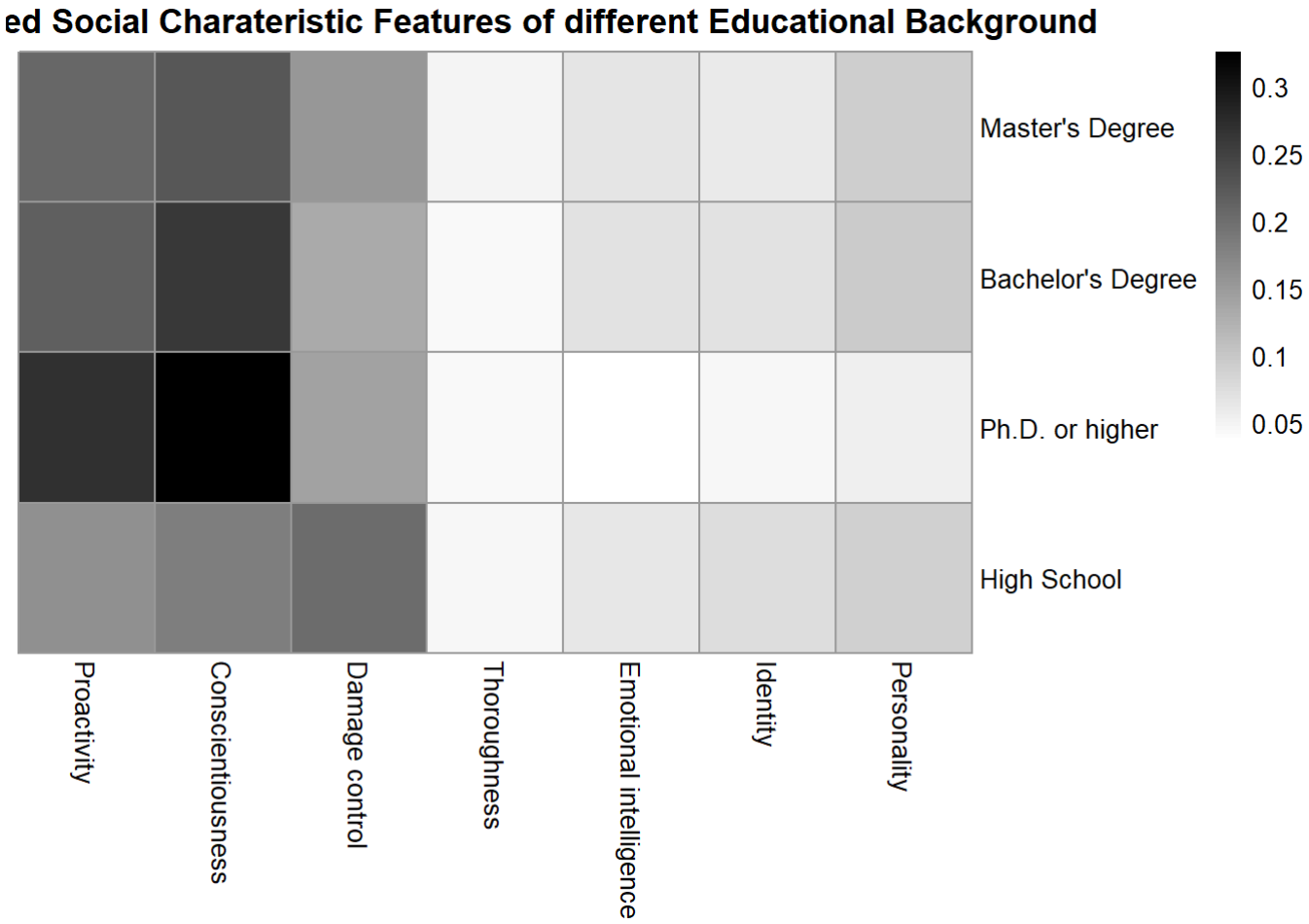

Social Charateristic Features of different Bachelor's Degree (Educational Backgro
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

ed Social Charateristic Features of different Ph.D. or higher (Educational Backgrou

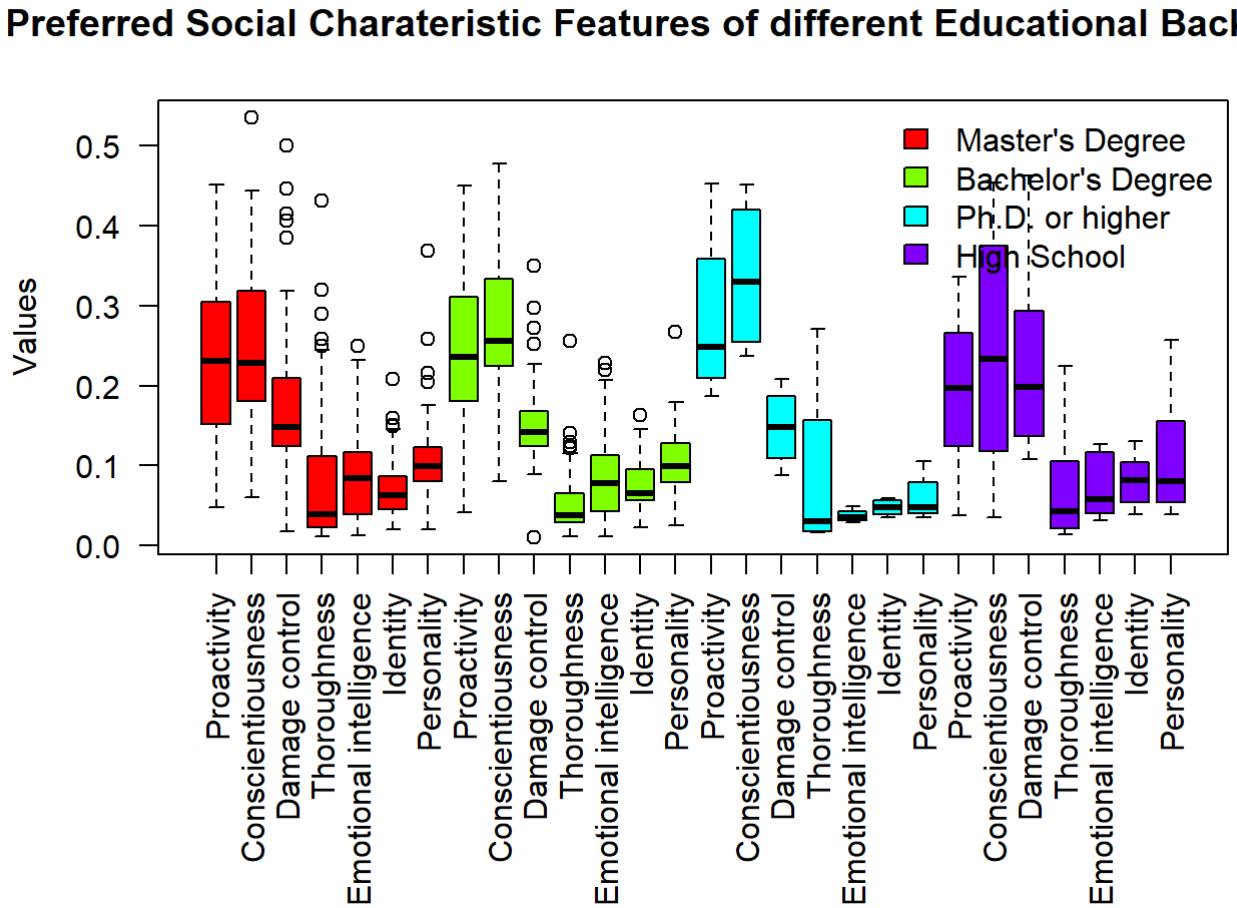


red Social Charateristic Features of different High School (Educational Backgrounc





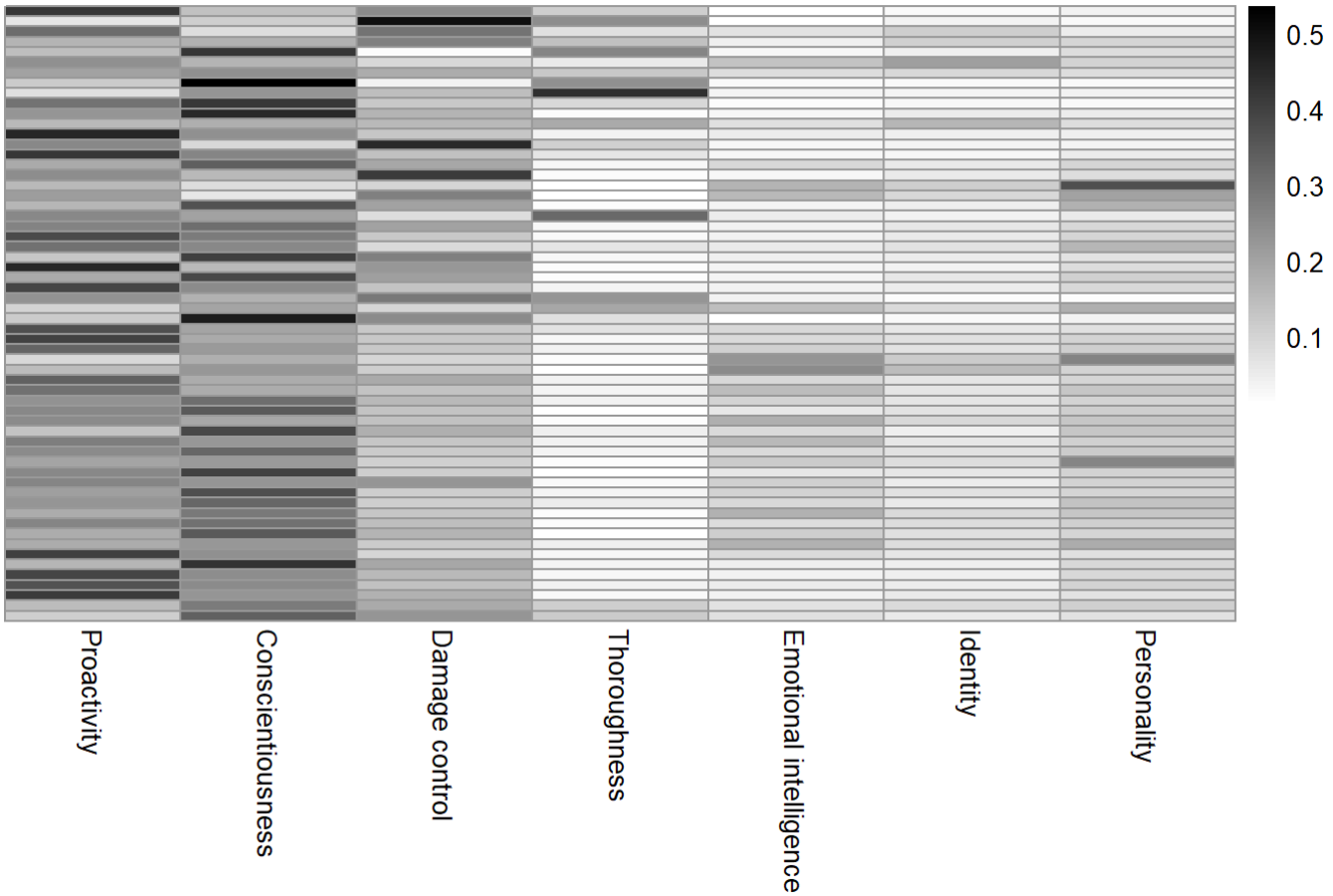

```
plot_box_plot(df, user_profiles, "edu", "Educational Background")
```



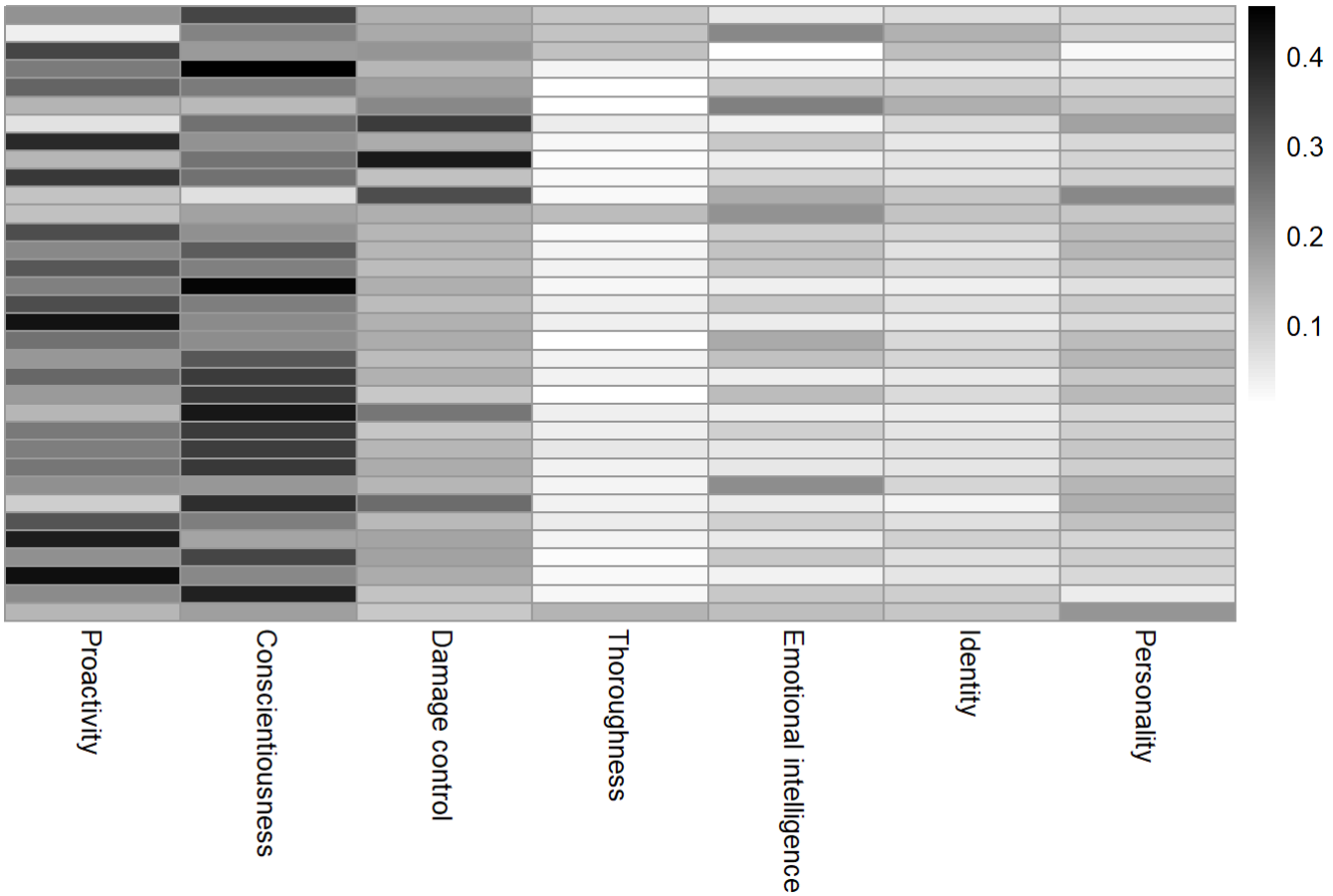
AHP on Familiarity with emerging technologies

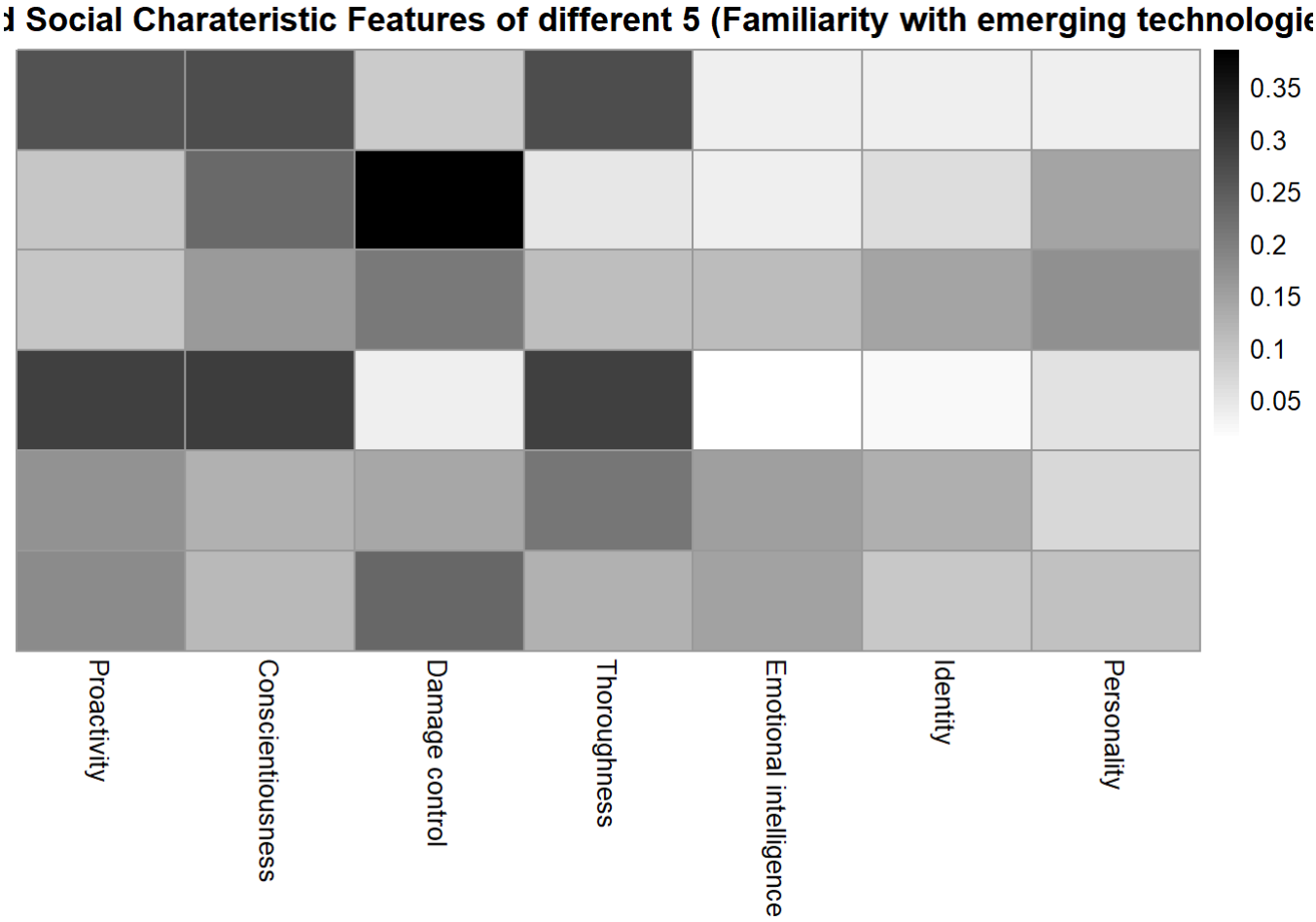
```
plot_heat_map(df, user_profiles, "fam", "Familiarity with emerging technologies")
```

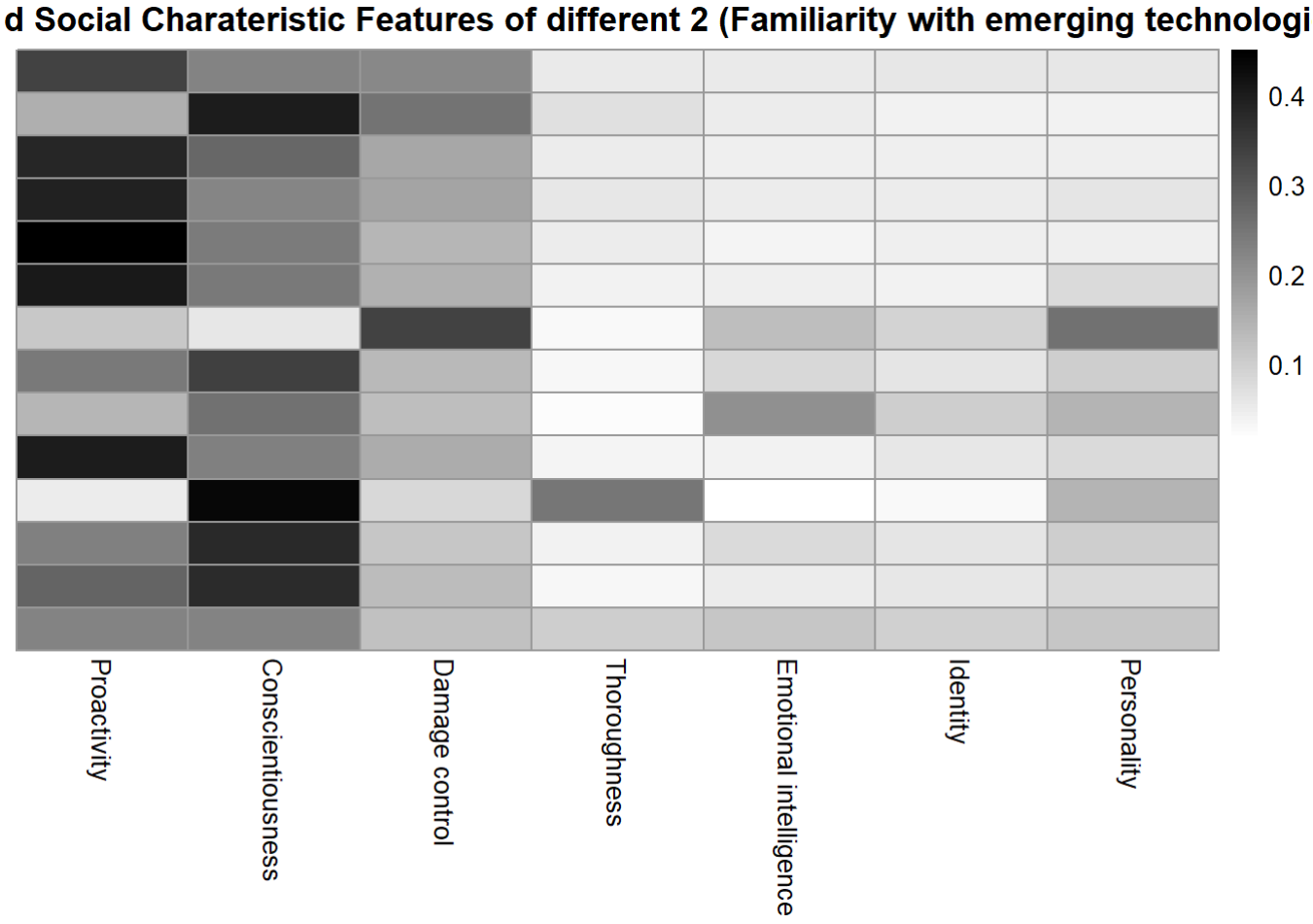
d Social Charateristic Features of different 4 (Familiarity with emerging technologi

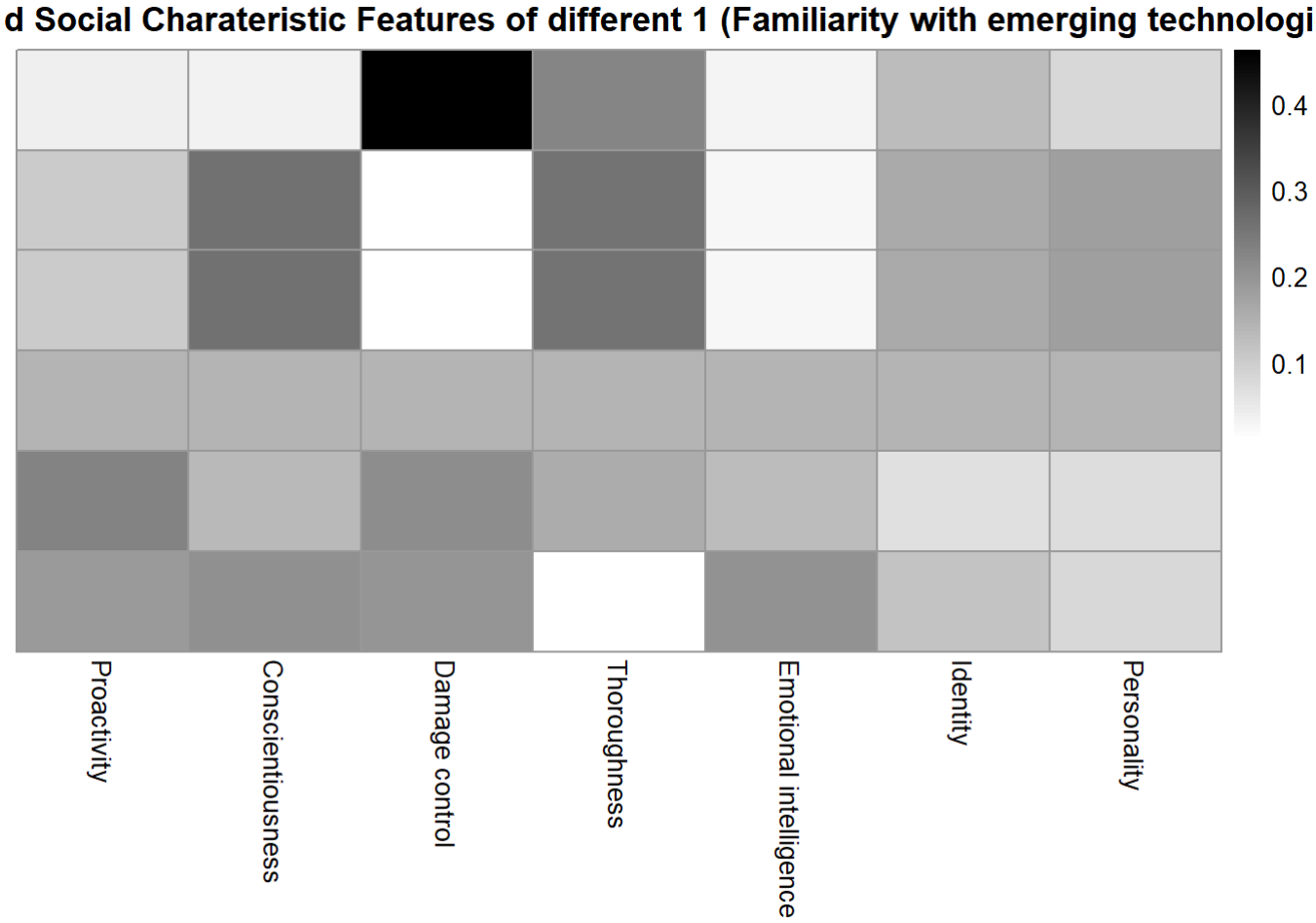


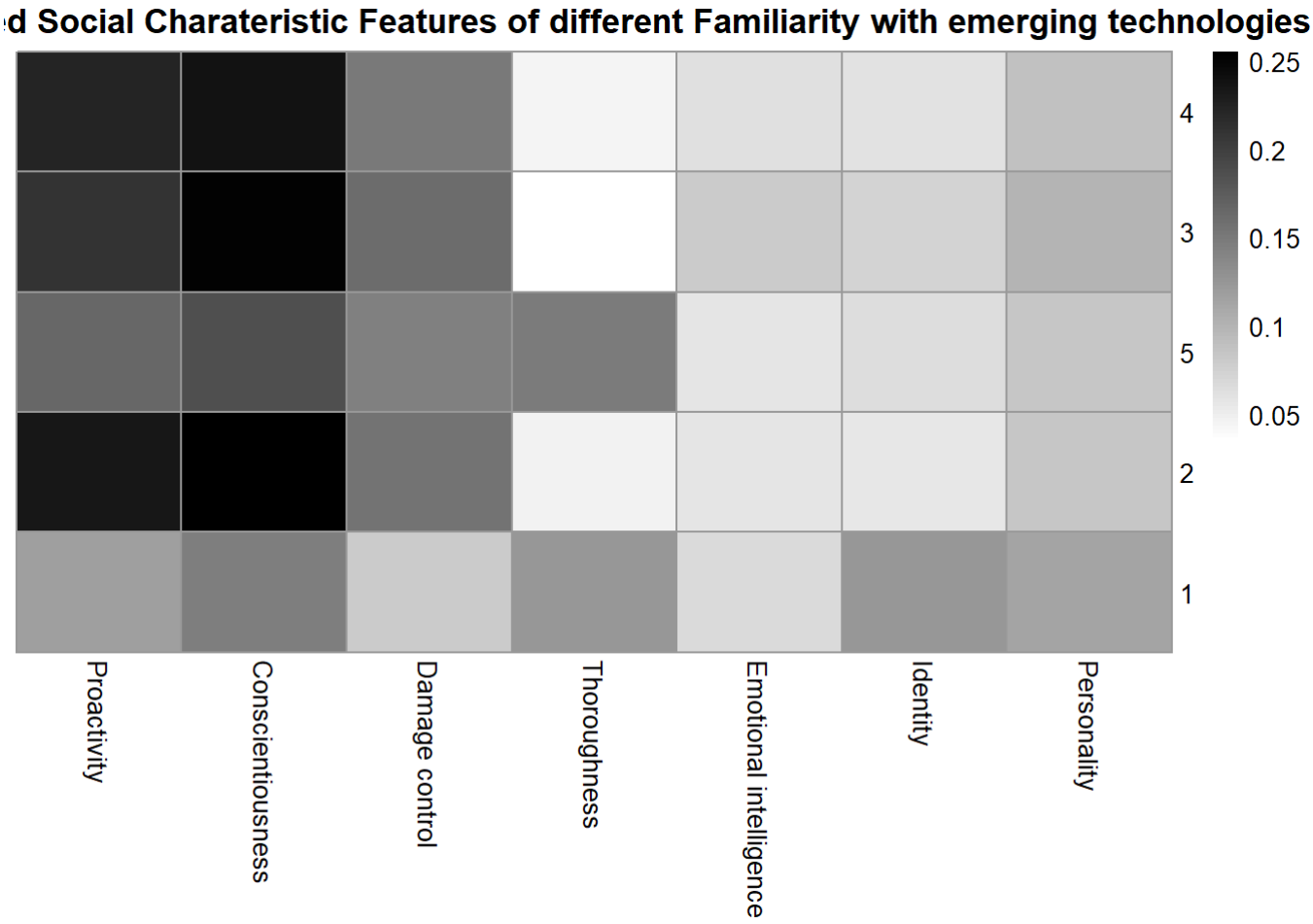
d Social Charateristic Features of different 3 (Familiarity with emerging technologi



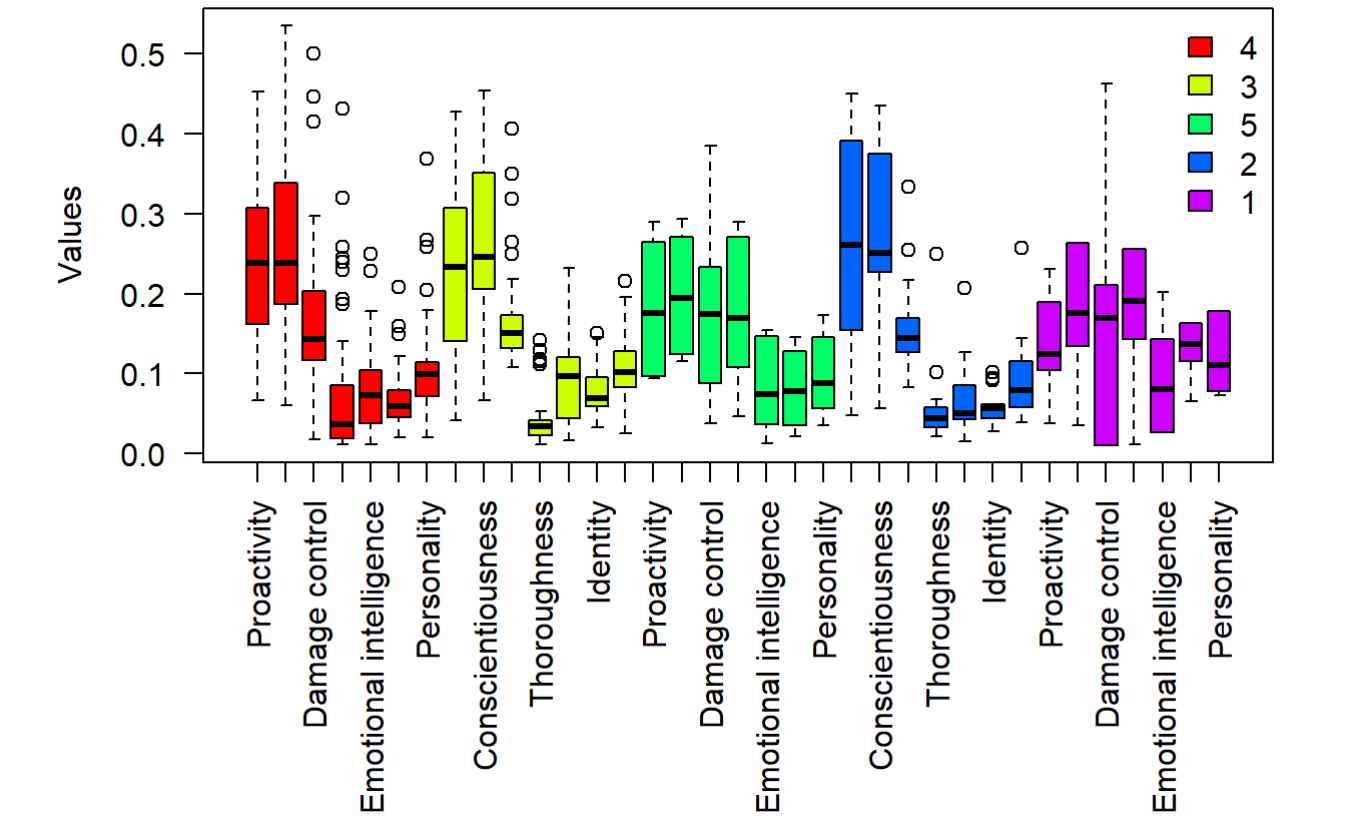

d Social Charateristic Features of different 5 (Familiarity with emerging technologie
0.35
0.3
0.25
0.2
0.15
0.1
0.05
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality


d Social Charateristic Features of different 2 (Familiarity with emerging technologi
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality



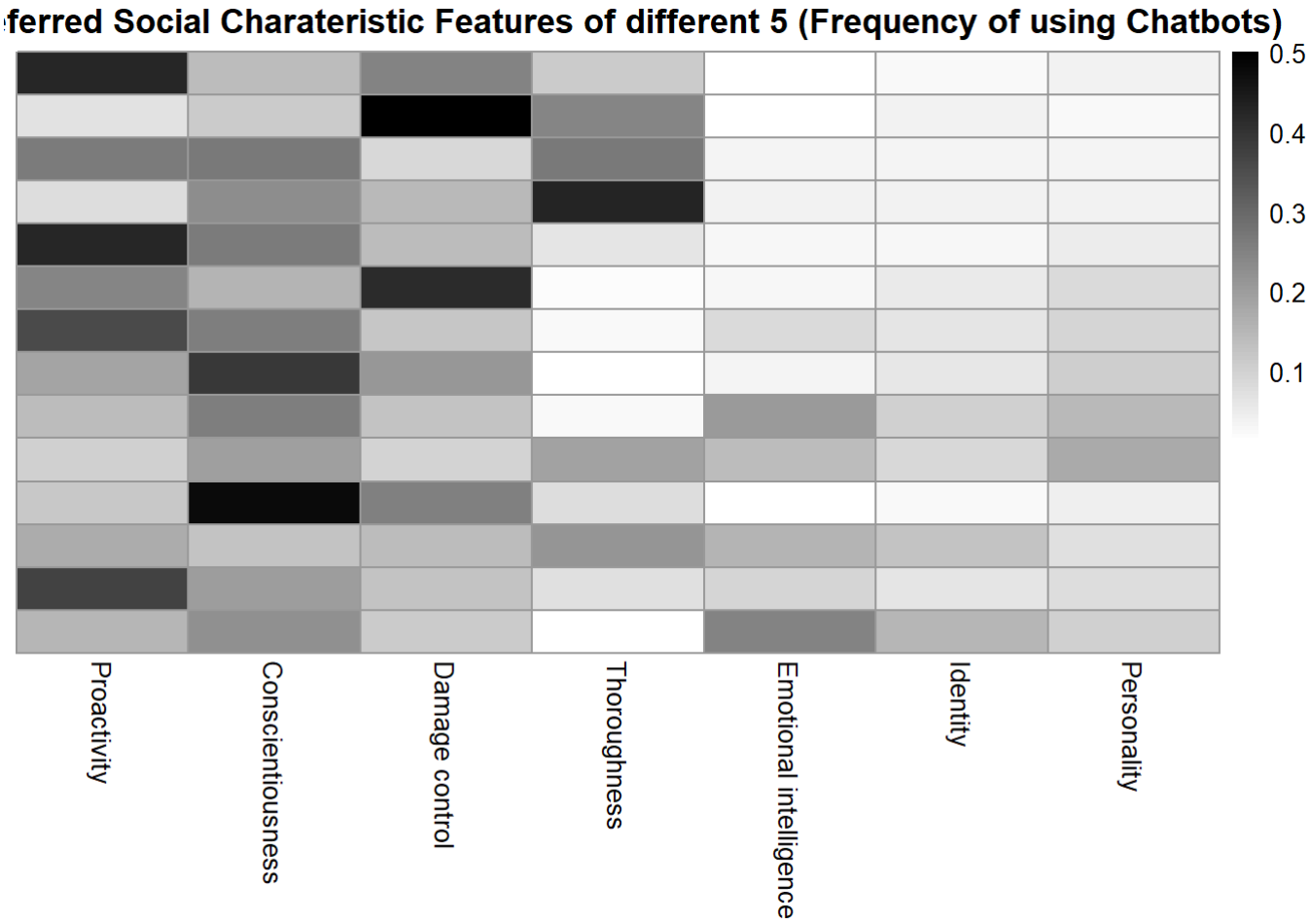


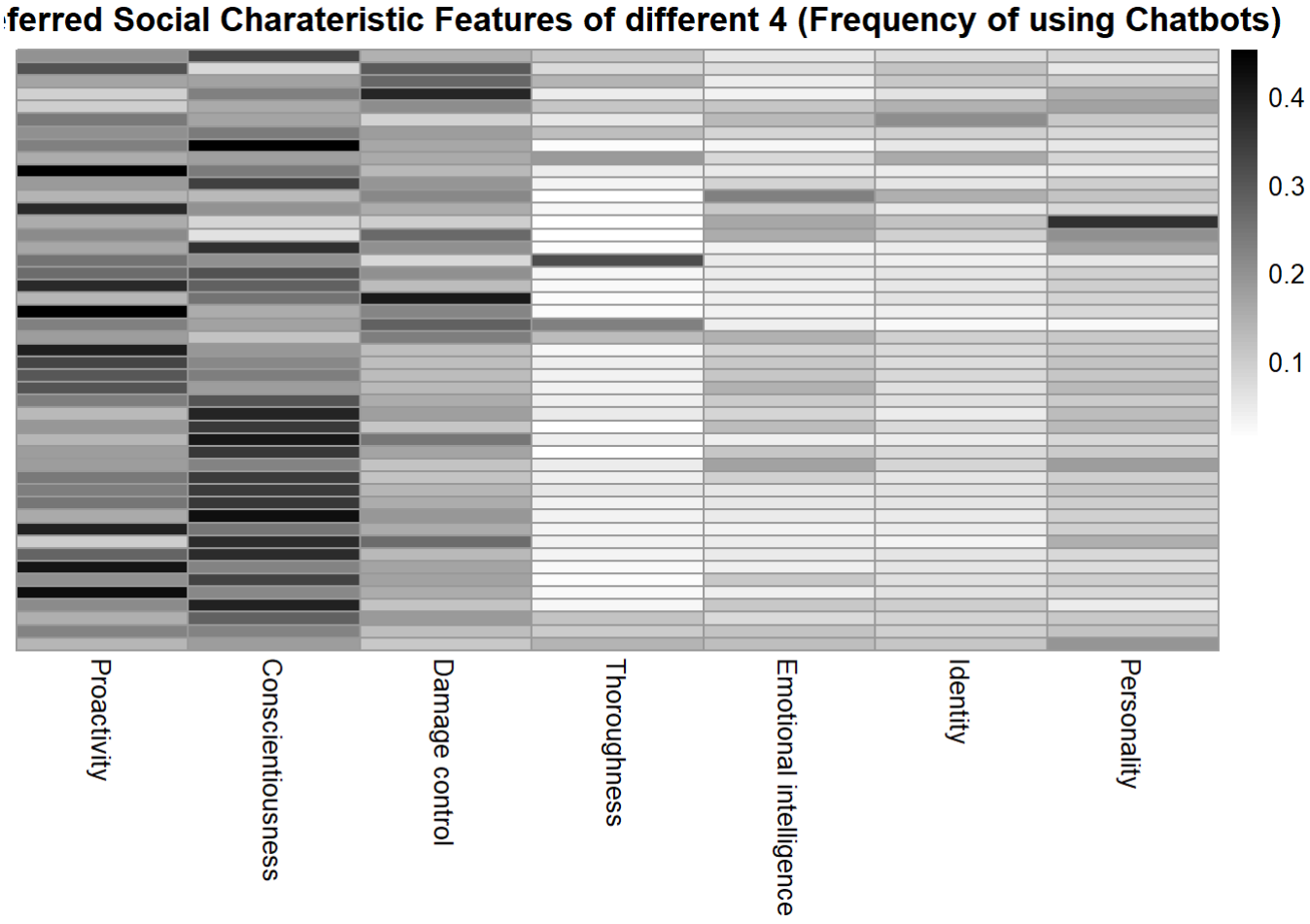

```
plot_box_plot(df, user_profiles, "fam", "Familiarity with emerging technologies")
```

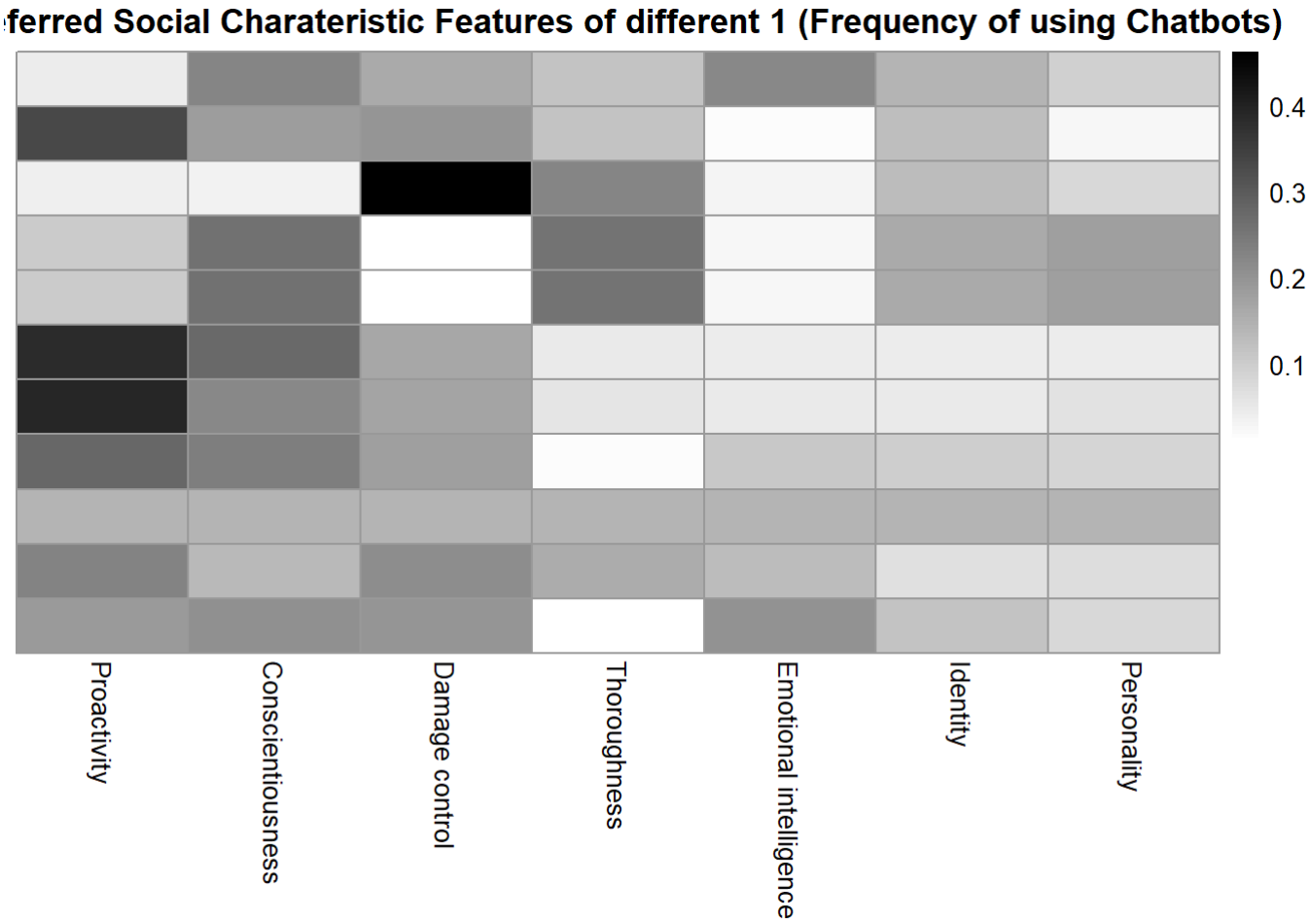


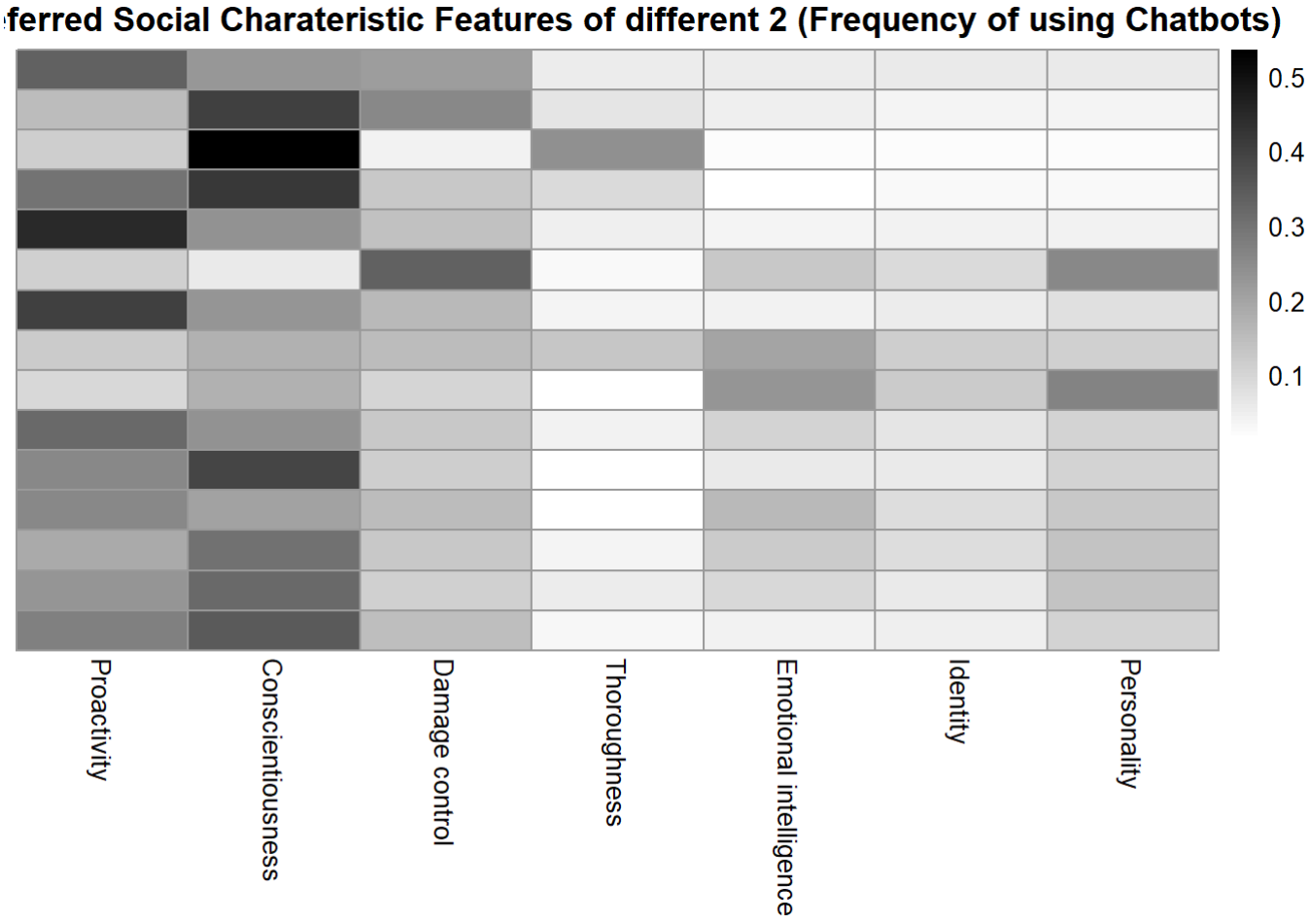
AHP on Frequency of Chatbot Usage

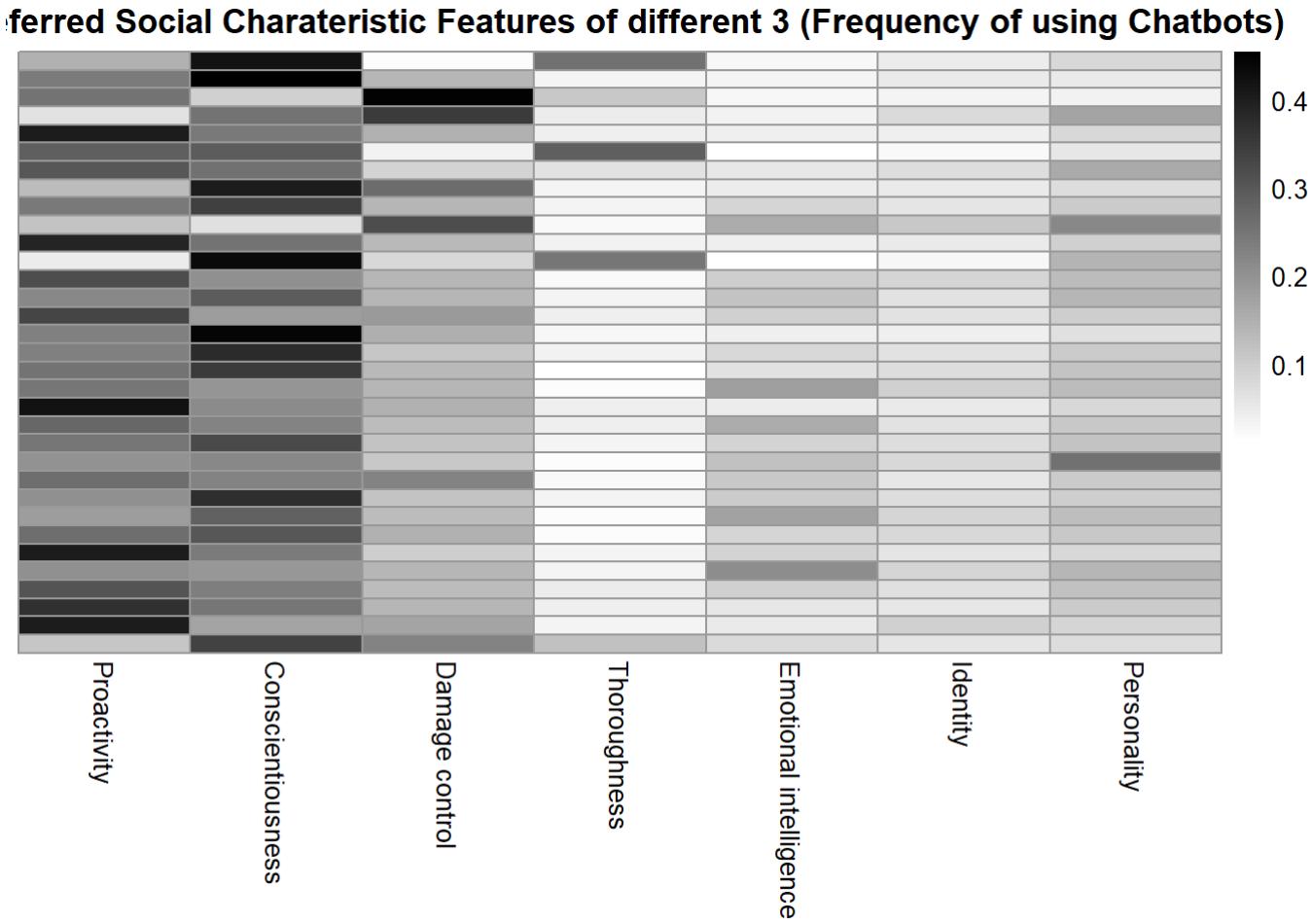
```
plot_heat_map(df, user_profiles, "freq", "Frequency of using Chatbots")
```

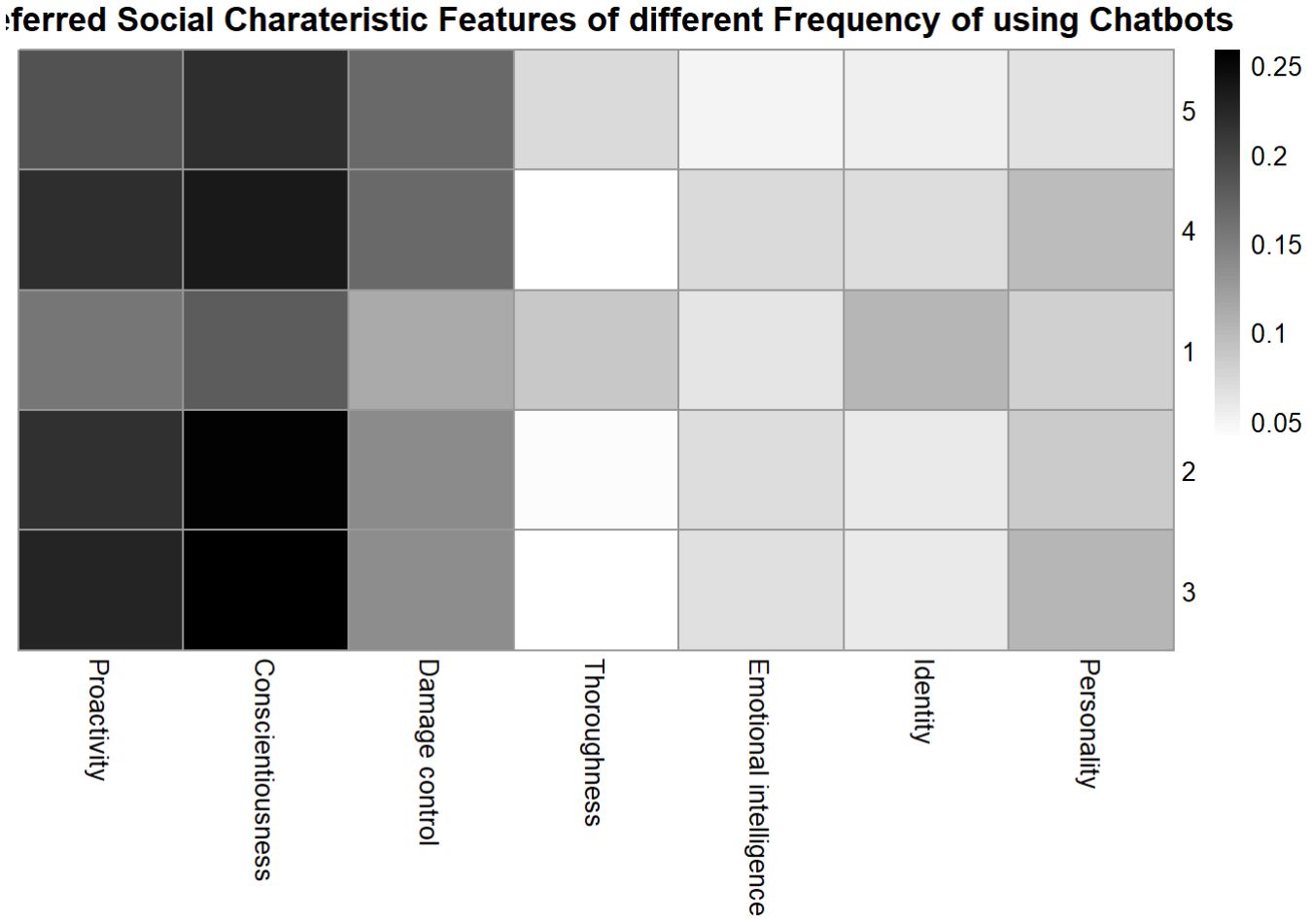

ferred Social Charateristic Features of different 5 (Frequency of using Chatbots)
0.5
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality


ferred Social Charateristic Features of different 4 (Frequency of using Chatbots)
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

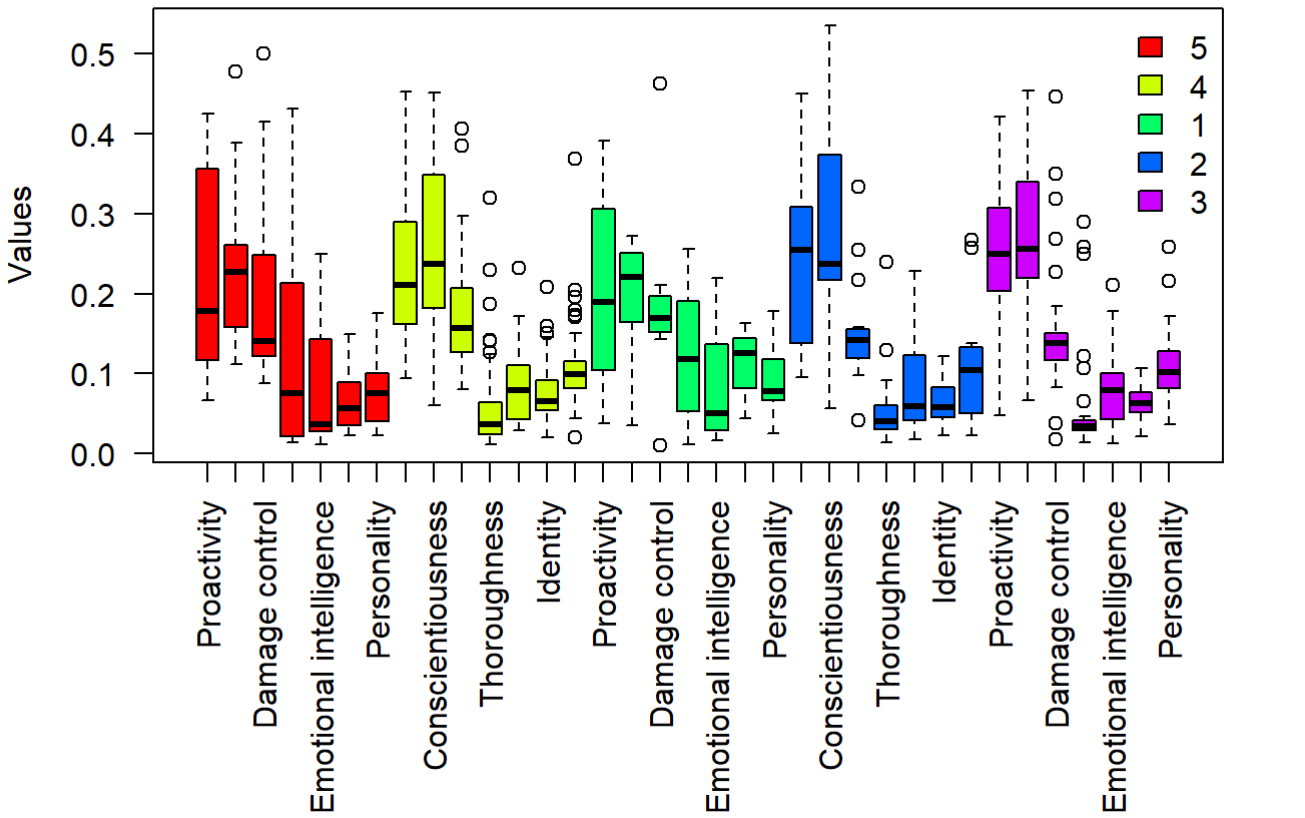

ferred Social Charateristic Features of different 1 (Frequency of using Chatbots)
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality


ferred Social Charateristic Features of different 2 (Frequency of using Chatbots)
0.5
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality





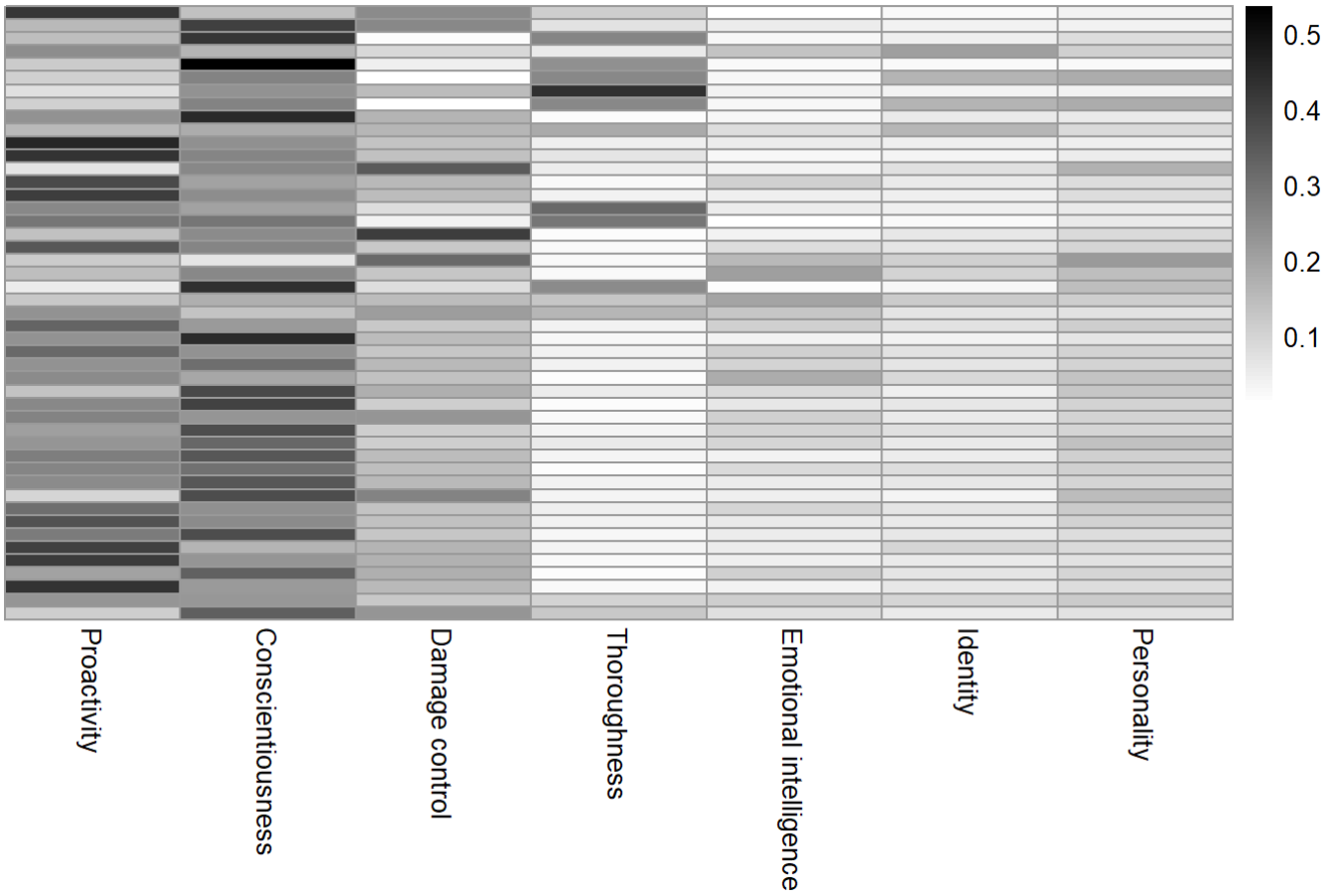

```
plot_box_plot(df, user_profiles, "freq", "Frequency of using Chatbots")
```



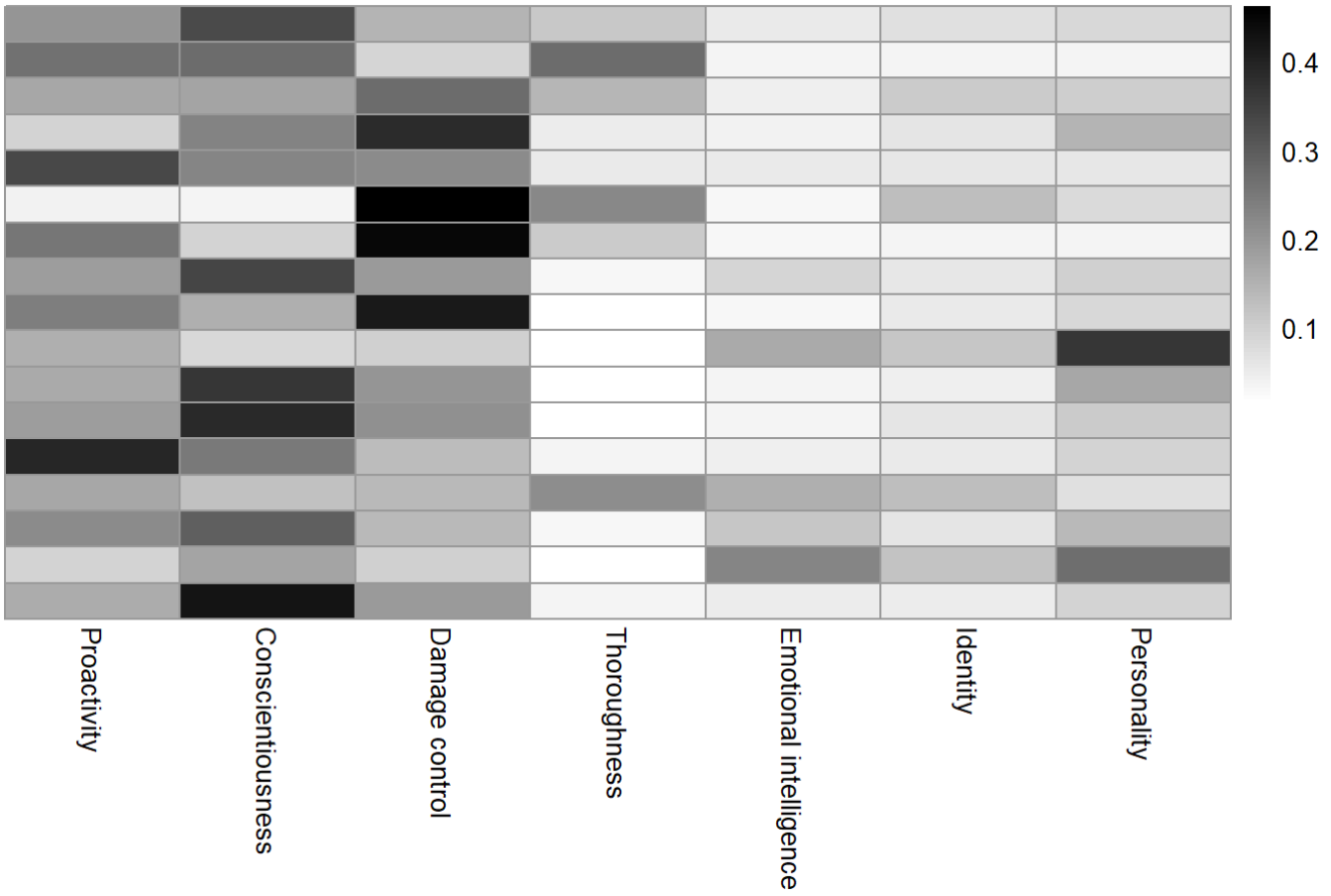
AHP on Overall satisfaction (IBM Chatbot)

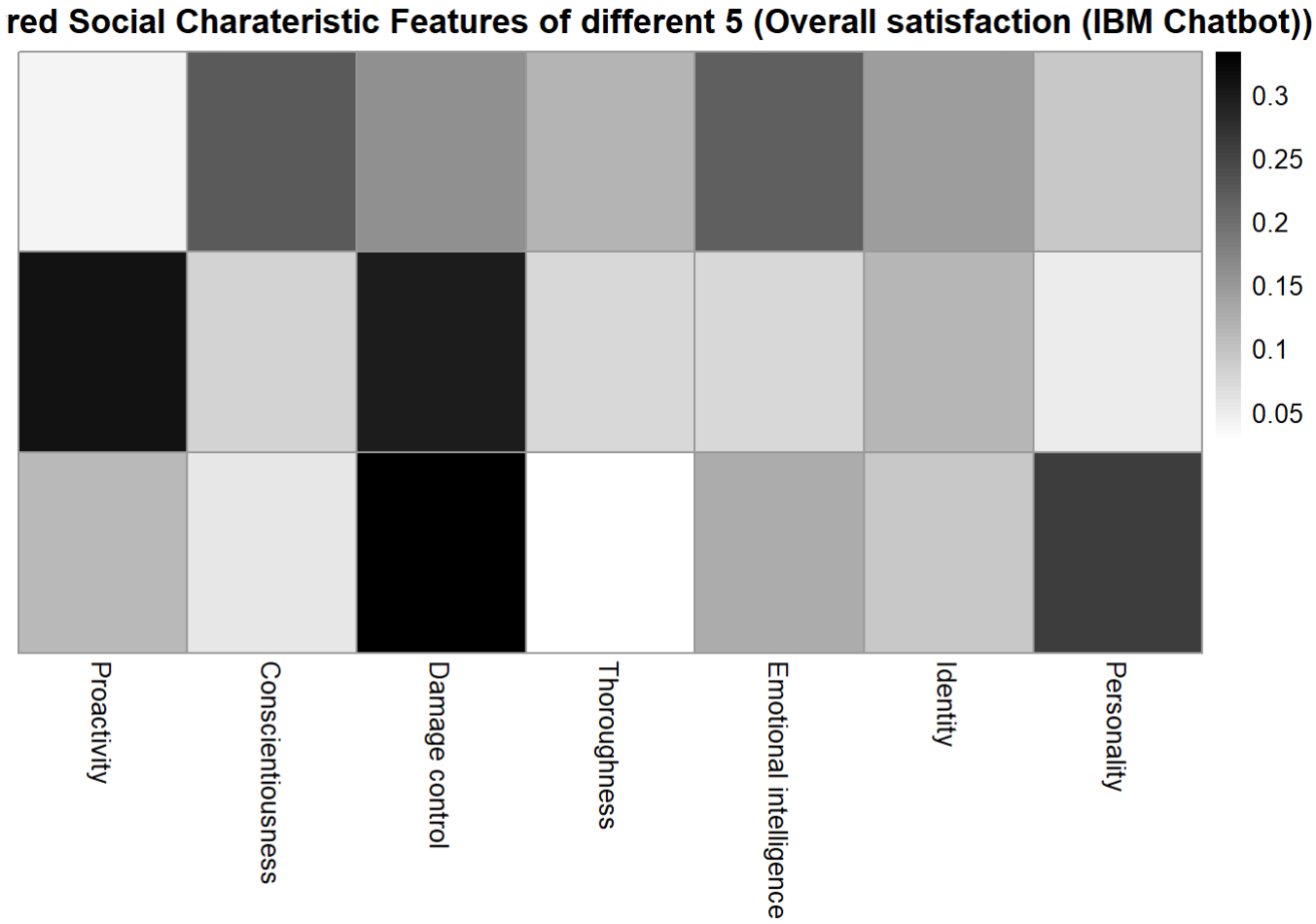
```
plot_heat_map(df, user_profiles, "sat", "Overall satisfaction (IBM Chatbot)")
```

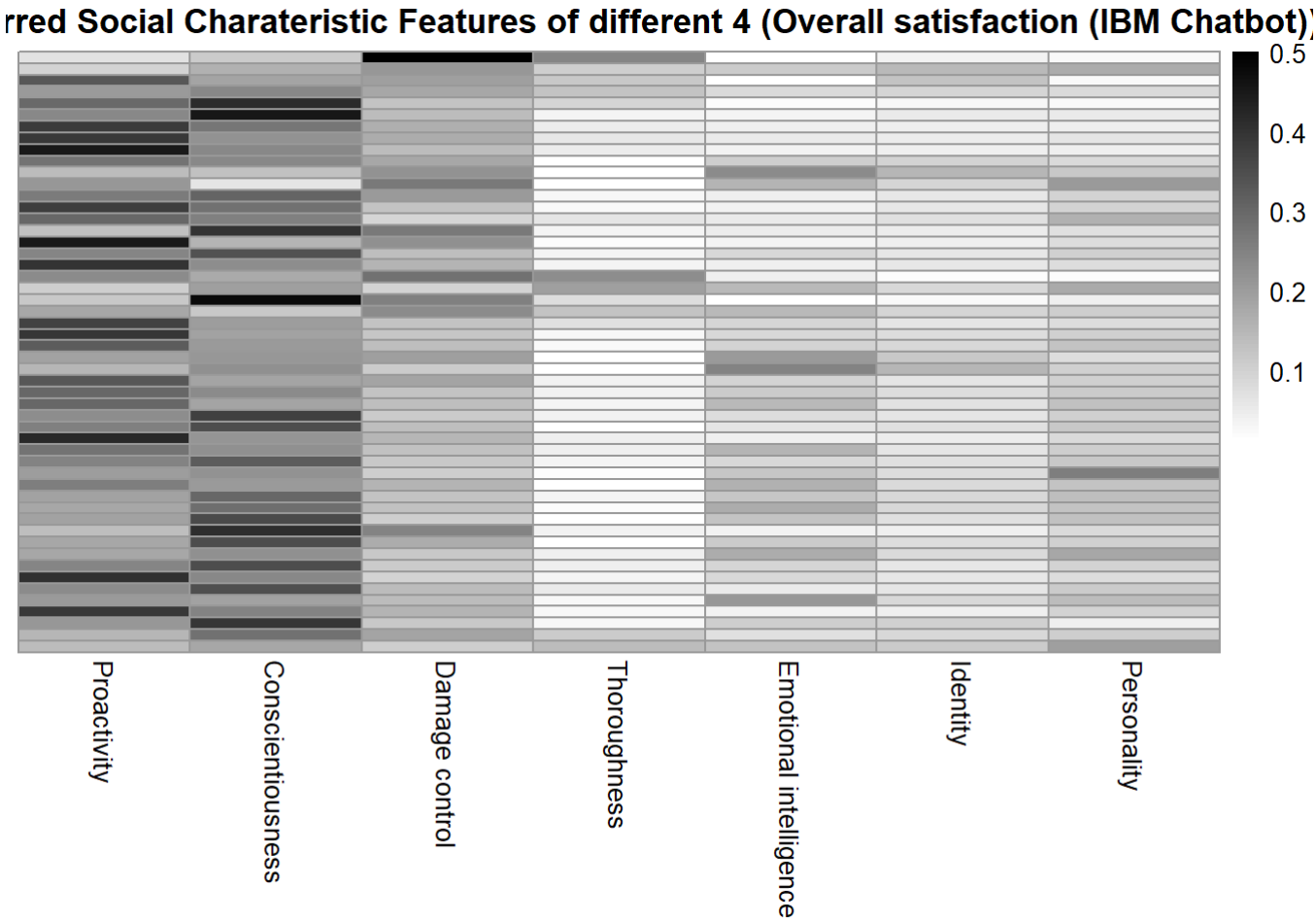
rred Social Charateristic Features of different 3 (Overall satisfaction (IBM Chatbot)



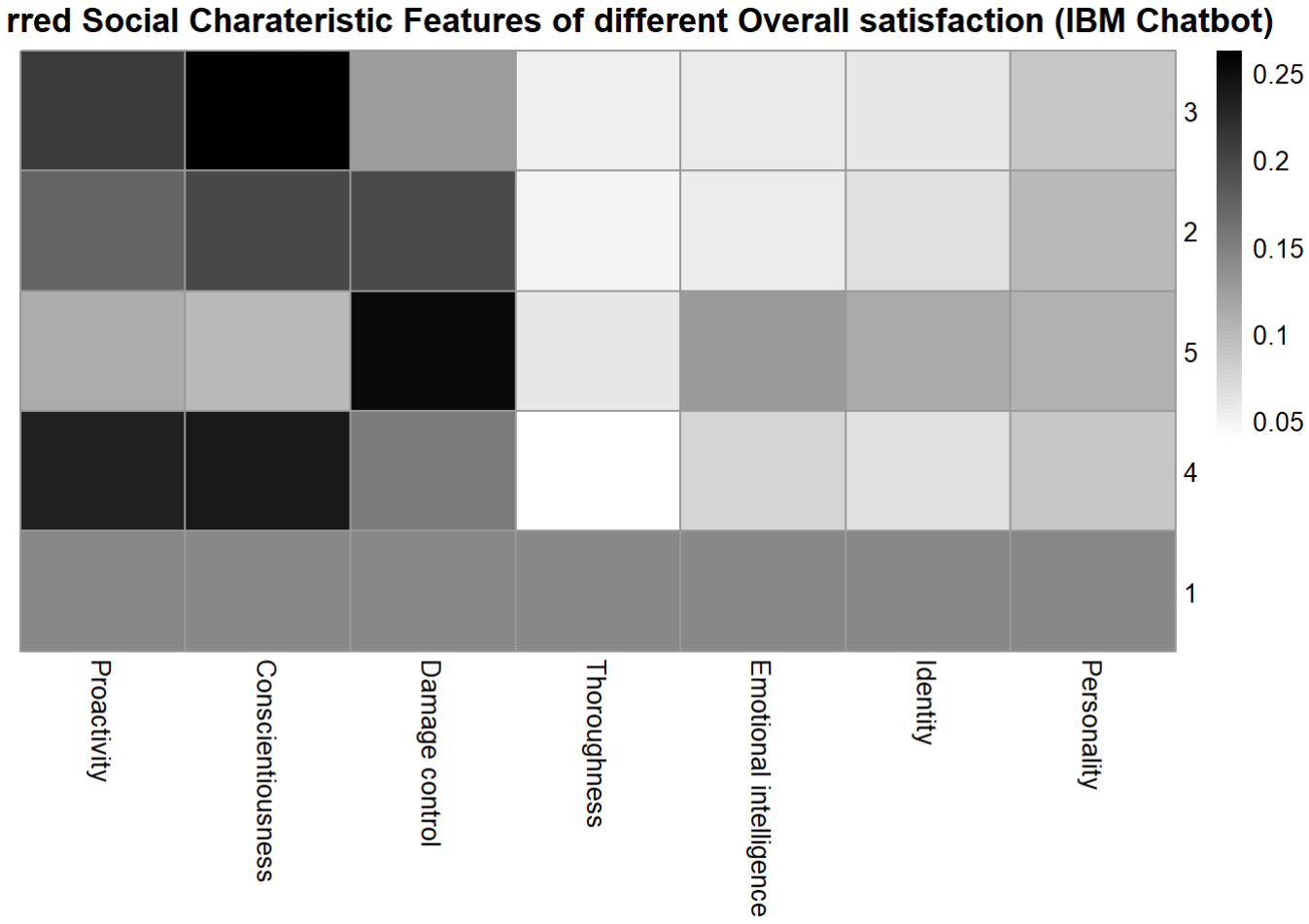
rred Social Charateristic Features of different 2 (Overall satisfaction (IBM Chatbot)



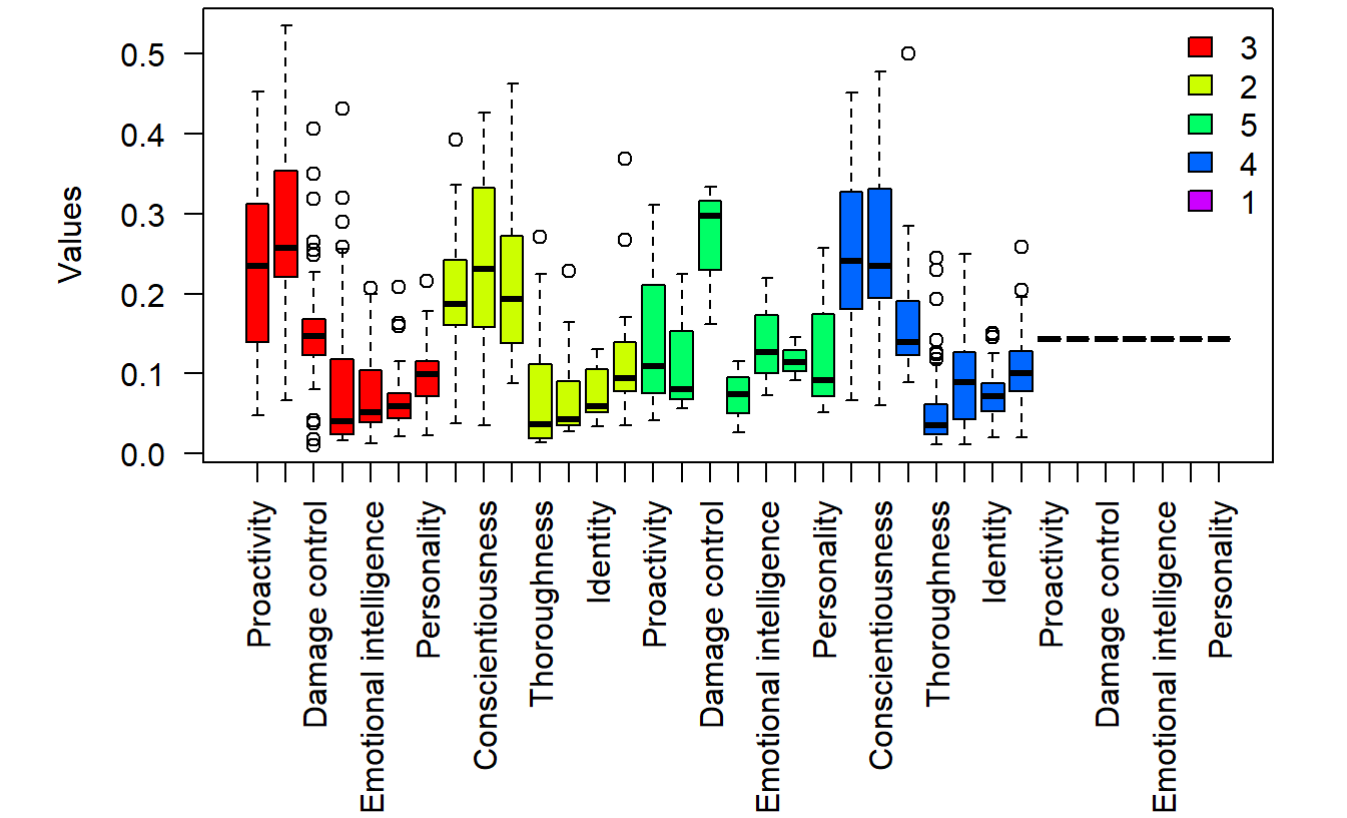

red Social Charateristic Features of different 5 (Overall satisfaction (IBM Chatbot))
0.3
0.25
0.2
0.15
0.1
0.05
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality


rred Social Charateristic Features of different 4 (Overall satisfaction (IBM Chatbot))
0.5
0.4
0.3
0.2
0.1
Proactivity
Conscientiousness
Damage control
Thoroughness
Emotional intelligence
Identity
Personality

```
## WARNING: there is only one rows of 1 in Overall satisfaction (IBM Chatbot)
## and all columns have the same value.
## The heatmap is omitted due to R will output error in this case.
## But this row will show up in the
## Preferred Social Charateristic Features of different Overall satisfaction (IBM Chatbot)
```




```
plot_box_plot(df, user_profiles, "sat", "Overall satisfaction (IBM Chatbot)")
```


eferred Social Charateristic Features of different Overall satisfaction (IBM
Values
0.0
0.1
0.2
0.3
0.4
0.5
3
2
5
4
1
Proactivity
Damage control
Emotional intelligence
Personality
Conscientiousness
Thoroughness
Identity
Proactivity
Damage control
Emotional intelligence
Personality
Conscientiousness
Thoroughness
Identity
Proactivity
Damage control
Emotional intelligence
Personality