Statistik für Digital Humanities

Gemischte ANOVA (GLM 5/5)

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Gemischte ANOVA

Bekannt:

- (einfaktorielle) ANOVA: Experiment durch Veränderung einer unabhängigen Variable (Gruppenzuordnung)
- ANCOVA: Experiment durch Veränderung einer unabhängigen Variable (Gruppenzuordnung) unter Eliminierung einer Variable außerhalb des Experiments
- Mehrfaktorielle ANOVA: Experiment durch Veränderung mehrerer unabhängigen Variablen (Gruppenzuordnungen)
- Abhängige ANOVA: Experiment durch Veränderung einer abhängigen Variable

Jetzt:

- Gemischte ANOVA: Experiment durch Veränderung (mindestens) einer abhängigen und einer unabhängigen Variable

Mehrfaktorielle ANOVA

Wir schauen uns jetzt eine dreifaktorielle gemischte ANOVA als Anschauungsbeispiel an.

Bibliotheken

```
install.packages("ez")
install.packages("ggplot2")
install.packages("nlme")
install.packages("pastecs")
install.packages("reshape")

#Initiate packages
library(ez)
library(ggplot2)
library(nlme)
library(pastecs)
library(reshape)
```

Daten

Gender	High Charisma	Low Charisma	Dullard
	Att — Avg — Ug	Att — Avg — Ug	Att — Avg — Ug
Male	86 — 84 — 67	88 — 69 — 50	97 — 48 — 47
	...— ...— ...	...— ...— ...	...— ...— ...
Female	89 — 91 — 93	88 — 65 — 54	56 — 48 — 52
	...— ...— ...	...— ...— ...	...— ...— ...

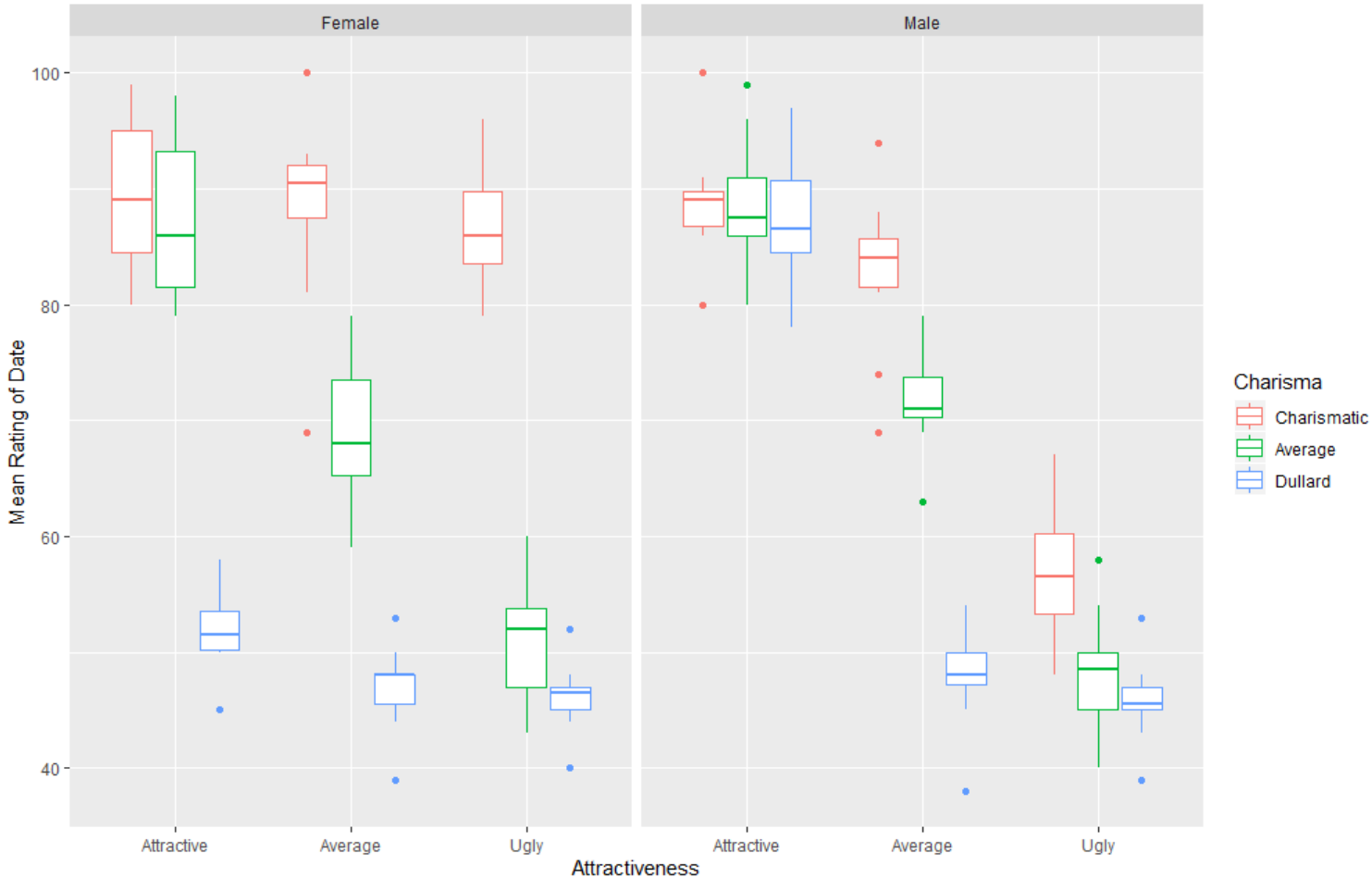
Moodle: LooksOrPersonality.dat

```
dateData<-read.delim("LooksOrPersonality.dat", header = TRUE)
speedData<-melt(dateData, id = c("participant","gender"), measured = c("att_high",
    "av_high", "ug_high", "att_some", "av_some", "ug_some", "att_none", "av_none",
    "ug_none"))
names(speedData)<-c("participant", "gender", "groups", "dateRating")
speedData$personality<-gl(3, 60, labels = c("Charismatic", "Average", "Dullard"))
speedData$looks<-gl(3,20, 180, labels = c("Attractive", "Average", "Ugly"))
speedData<-speedData[order(speedData$participant),]
```

Daten

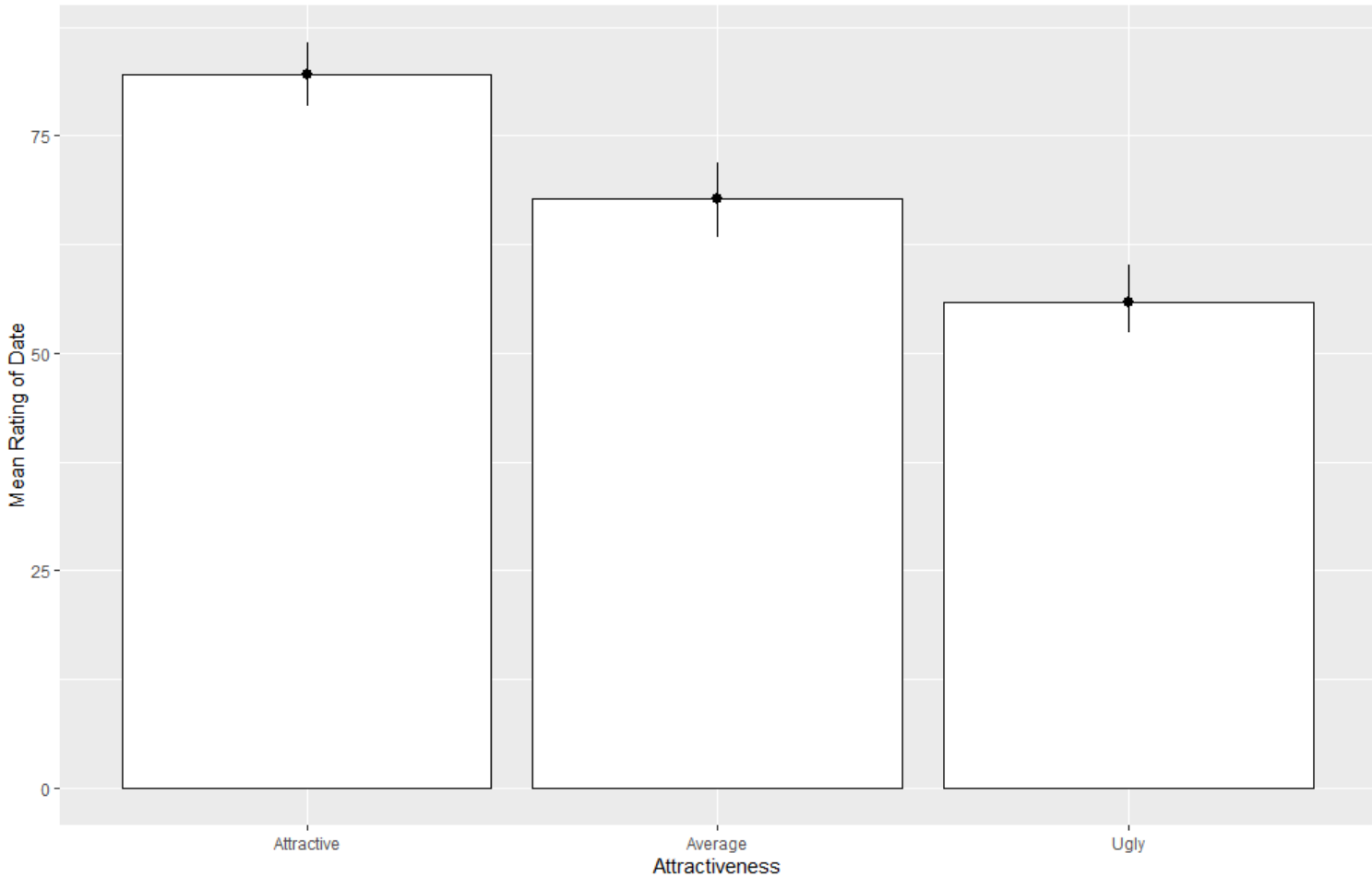
participant	gender	groups	dateRating	personality	looks
P01	Male	att_high	86	Charismatic	Attractive
P01	Male	av_high	84	Charismatic	Average
P01	Male	ug_high	67	Charismatic	Ugly
P01	Male	att_some	88	Average	Attractive
P01	Male	av_some	69	Average	Average
P01	Male	ug_some	50	Average	Ugly
P01	Male	att_none	97	Dullard	Attractive
P01	Male	av_none	48	Dullard	Average
P01	Male	ug_none	47	Dullard	Ugly
P02	Male	att_high	91	Charismatic	Attractive
P02	Male	av_high	83	Charismatic	Average
P02	Male	ug_high	53	Charismatic	Ugly
P02	Male	att_some	83	Average	Attractive
P02	Male	av_some	74	Average	Average
P02	Male	ug_some	48	Average	Ugly

Boxplots



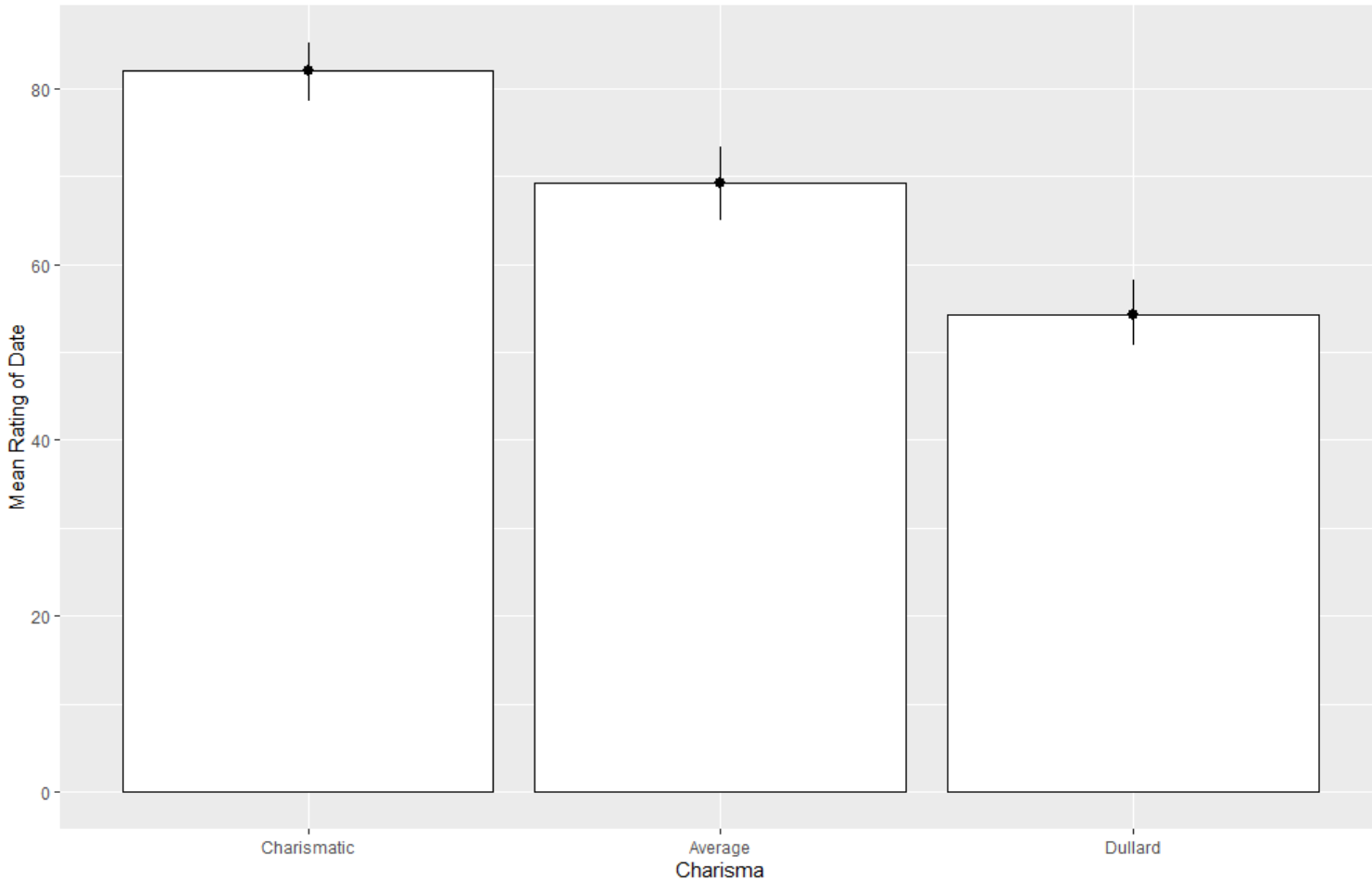

```
dateBoxplot<-ggplot(speedData,aes(looks,dateRating,colour=personality))
dateBoxplot+geom_boxplot()+labs(x="Attractiveness",y="Mean Rating of Date",
    colour="Charisma")+facet_wrap(~gender)
```

Balken Looks



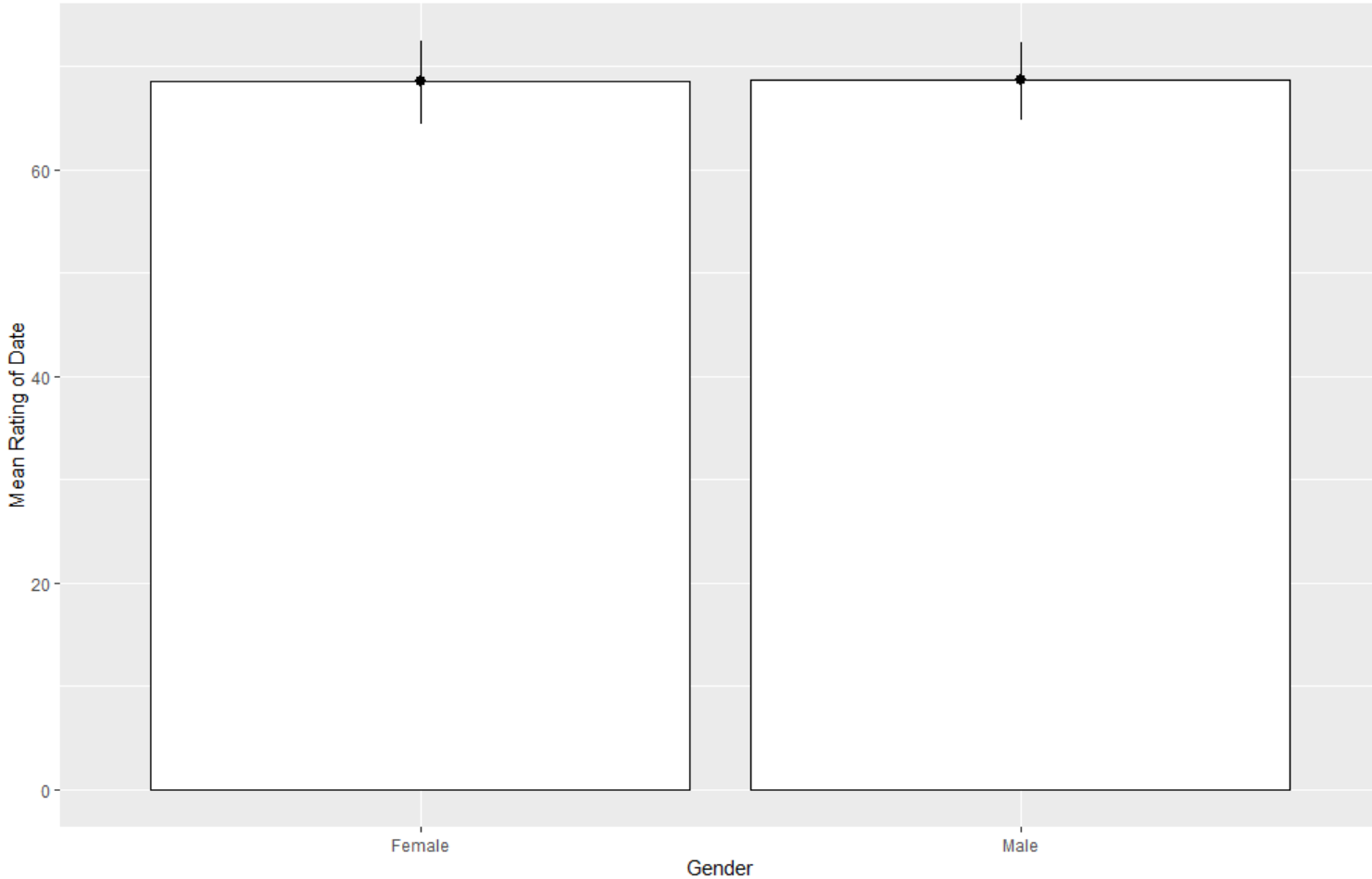

```
looksBar <- ggplot(speedData, aes(looks, dateRating))
looksBar + stat_summary(fun.y = mean, geom = "bar", fill = "White",
    colour = "Black") + stat_summary(fun.data = mean_cl_boot,
    geom = "pointrange") + labs(x = "Attractiveness", y = "Mean Rating of Date")
```

Balken Charisma



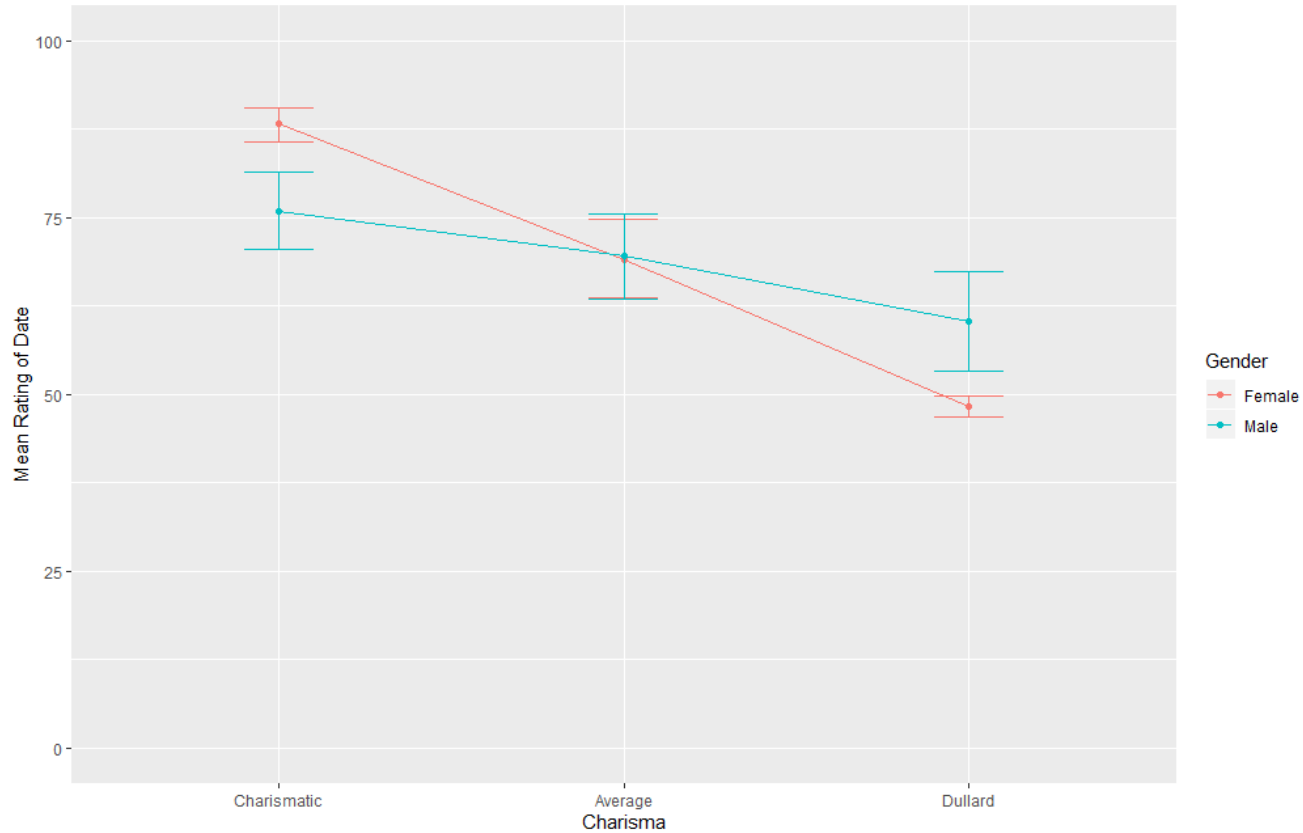

```
charismaBar <- ggplot(speedData, aes(personality, dateRating))
charismaBar + stat_summary(fun.y = mean, geom = "bar", fill = "White",
    colour = "Black") + stat_summary(fun.data = mean_cl_boot,
    geom = "pointrange") + labs(x = "Charisma", y = "Mean Rating of Date")
```

Balken Gender



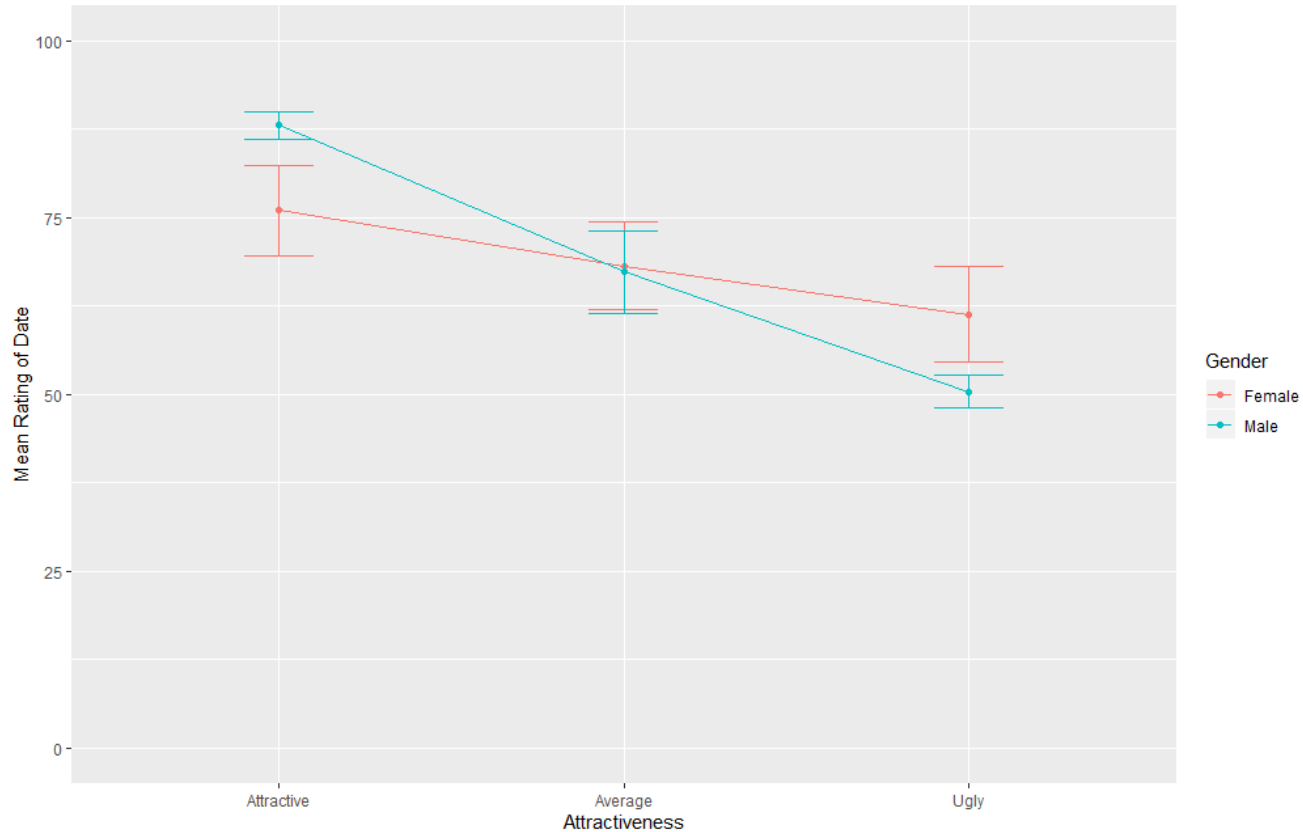

```
genderBar <- ggplot(speedData, aes(gender, dateRating))
genderBar + stat_summary(fun.y = mean, geom = "bar", fill = "White",
    colour = "Black") + stat_summary(fun.data = mean_cl_boot,
    geom = "pointrange") + labs(x = "Gender", y = "Mean Rating of Date")
```

Interaktion Gender Charisma



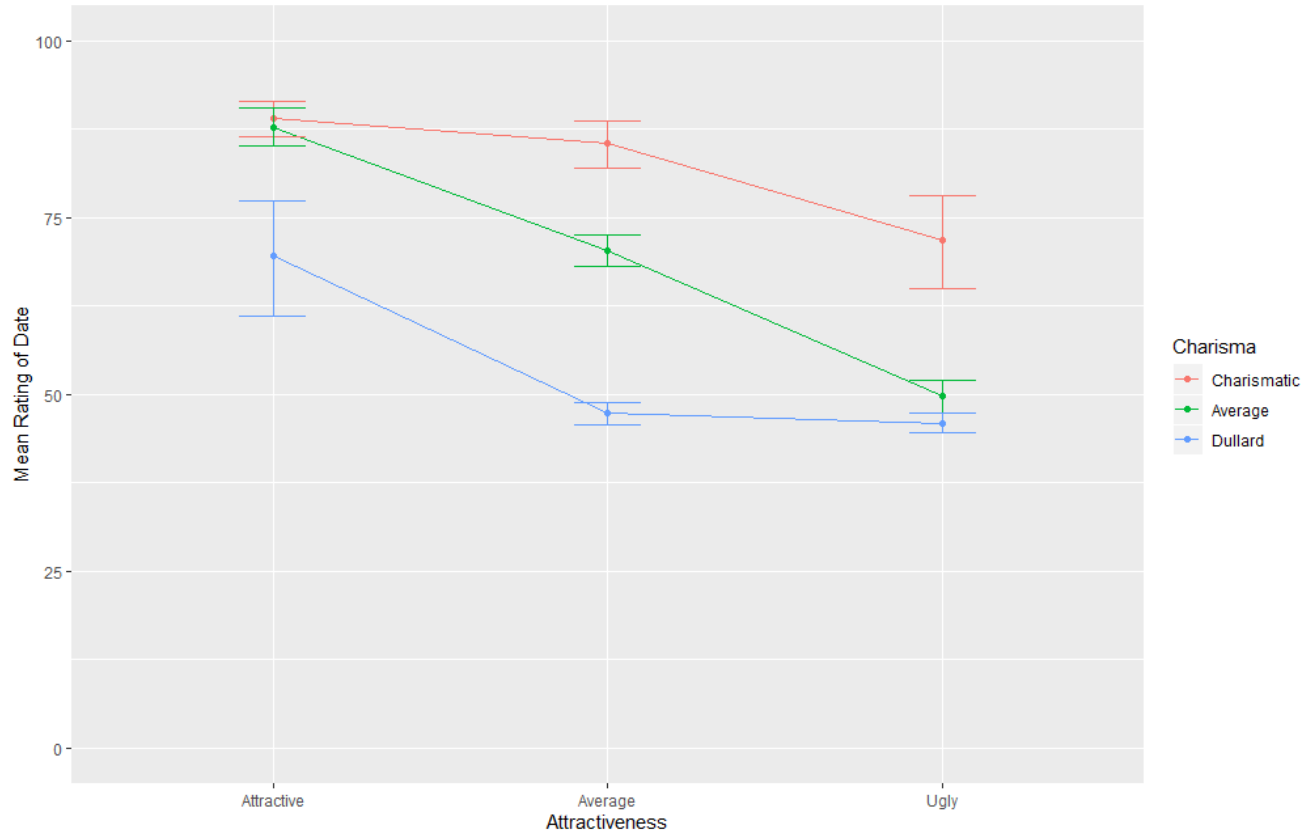

```
genderCharisma <- ggplot(speedData, aes(personality, dateRating,
    colour = gender))
genderCharisma + stat_summary(fun.y = mean, geom = "point") +
    stat_summary(fun.y = mean, geom = "line", aes(group= gender)) +
    stat_summary(fun.data = mean_cl_boot, geom = "errorbar", width = 0.2) +
    labs(x = "Charisma", y = "Mean Rating of Date", colour = "Gender") +
    scale_y_continuous(limits = c(0,100))
```

Interaktion Gender Looks



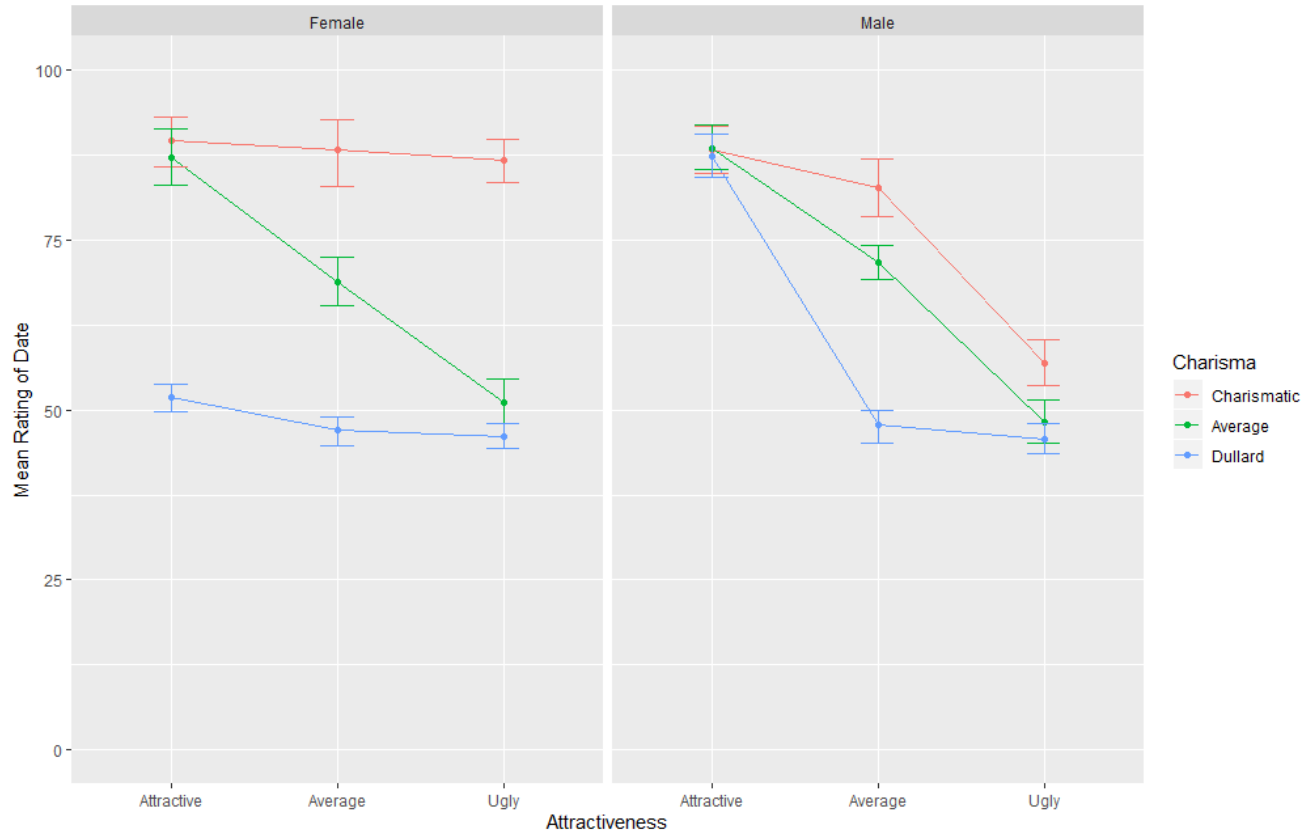

```
genderLooks <- ggplot(speedData, aes(looks, dateRating, colour = gender))
genderLooks + stat_summary(fun.y = mean, geom = "point")
    + stat_summary(fun.y = mean, geom = "line", aes(group= gender))
    + stat_summary(fun.data = mean_cl_boot, geom = "errorbar", width = 0.2)
    + labs(x = "Attractiveness", y = "Mean Rating of Date", colour = "Gender") +
    scale_y_continuous(limits = c(0,100))
```

Interaktion Looks Charisma




```
looksCharisma <- ggplot(speedData, aes(looks, dateRating, colour = personality))
looksCharisma + stat_summary(fun.y = mean, geom = "point")
    + stat_summary(fun.y = mean, geom = "line", aes(group= personality))
    + stat_summary(fun.data = mean_cl_boot, geom = "errorbar", width = 0.2)
    + labs(x = "Attractiveness", y = "Mean Rating of Date", colour = "Charisma")
    + scale_y_continuous(limits = c(0,100))
```

Interaktion Gender Looks Charisma




```
looksCharismaGender <- ggplot(speedData, aes(looks, dateRating, colour = personalit
looksCharismaGender + stat_summary(fun.y = mean, geom = "point")
    + stat_summary(fun.y = mean, geom = "line", aes(group= personality))
    + stat_summary(fun.data = mean_cl_boot, geom = "errorbar", width = 0.2)
    + labs(x = "Attractiveness", y = "Mean Rating of Date", colour = "Charisma")
    + scale_y_continuous(limits = c(0,100)) + facet_wrap(~gender)
```

Überblick

```
by(speedData$dateRating, list(speedData$looks, speedData$personality,
    speedData$gender), stat.desc, basic = FALSE)

: Attractive
: Charismatic
: Female
      median         mean      SE.mean CI.mean.0.95          var      std.dev     coef.var
 89.00000000  89.60000000   2.09867683   4.74753683  44.04444444   6.63659886   0.07406918
------------------------------------------------------------------------
: Average
: Charismatic
: Female
      median         mean      SE.mean CI.mean.0.95          var      std.dev     coef.var
 90.50000000  88.40000000   2.63396617   5.95844544  69.37777778   8.32933237   0.09422322
------------------------------------------------------------------------
: Average
: Dullard
: Male
      median         mean      SE.mean CI.mean.0.95          var      std.dev     coef.var
 48.00000000  47.80000000   1.32329555   2.99350251  17.51111111   4.18462795   0.08754452
------------------------------------------------------------------------
: Ugly
: Dullard
: Male
      median         mean      SE.mean CI.mean.0.95          var      std.dev     coef.var
 45.50000000  45.80000000   1.13333333   2.56377812  12.84444444   3.58391468   0.07825141

*Und so weiter*
```

Kontraste

Wir bauen orthogonale Kontraste analog zu vorher

- *ugly* und *dullard* als Kontrollgruppen
- *att vs avg* und *high vs low* als Untersuchungseinheit

Gruppe	Kontr 1	Kontr 2
Attractive	1	-1
Average	1	1
Ugly	-2	0

Gruppe	Kontr 1	Kontr 2
Charismatic	1	-1
Average	1	1
Dullard	-2	0

```
SomevsNone<-c(1, 1, -2)
HivsAv<-c(1, -1, 0)
contrasts(speedData$personality)<-cbind(SomevsNone, HivsAv)

AttractivevsUgly<-c(1, 1, -2)
AttractvsAv<-c(1, -1, 0)
contrasts(speedData$looks)<-cbind(AttractivevsUgly, AttractvsAv)
```

Modell berechnen (als ANOVA)

```
options(digits = 3)
speedModel<-ezANOVA(data = speedData, dv = .(dateRating), wid = .(participant),
    between = .(gender), within = .(looks, personality), type = 3, detailed = TRUE)
speedModel
options(digits = 7)
```

```
                  Effect DFn DFd      SSn  SSd        F        p p<.05      ges
1            (Intercept)   1  18 846249.8  760 2.00e+04 7.01e-29     * 9.94e-01
2                 gender   1  18      0.2  760 4.74e-03 9.46e-01       4.07e-05
3                  looks   2  36  20779.6  883 4.24e+02 9.59e-26     * 8.09e-01
5            personality   2  36  23233.6 1274 3.28e+02 7.69e-24     * 8.26e-01
4           gender:looks   2  36   3944.1  883 8.04e+01 5.23e-14     * 4.45e-01
6      gender:personality   2  36   4420.1 1274 6.24e+01 1.97e-12     * 4.74e-01
7       looks:personality   4  72   4055.3 1993 3.66e+01 1.10e-16     * 4.52e-01
8 gender:looks:personality   4  72   2669.7 1993 2.41e+01 1.11e-12     * 3.52e-01
$`Mauchly's Test for Sphericity`
                  Effect     W     p p<.05
3                  looks 0.960 0.708
4           gender:looks 0.960 0.708
5            personality 0.929 0.536
6      gender:personality 0.929 0.536
7       looks:personality 0.613 0.534
8 gender:looks:personality 0.613 0.534
$`Sphericity Corrections`
                  Effect   GGe    p[GG] p[GG]<.05   HFe    p[HF] p[HF]<.05
3                  looks 0.962 7.62e-25         * 1.074 9.59e-26         *
4           gender:looks 0.962 1.49e-13         * 1.074 5.23e-14         *
5            personality 0.934 2.06e-22         * 1.038 7.69e-24         *
6      gender:personality 0.934 9.44e-12         * 1.038 1.97e-12         *
7       looks:personality 0.799 9.00e-14         * 0.992 1.43e-16         *
8 gender:looks:personality 0.799 1.47e-10         * 0.992 1.34e-12         *
```

Modell auswerten

	Effect	DFn	DFd	SSn	SSd	F	p	p<.05	ges
1	(Intercept)	1	18	846249.8	760	2.00e+04	7.01e-29	*	9.94e-01
2	gender	1	18	0.2	760	4.74e-03	9.46e-01		4.07e-05
3	looks	2	36	20779.6	883	4.24e+02	9.59e-26	*	8.09e-01
5	personality	2	36	23233.6	1274	3.28e+02	7.69e-24	*	8.26e-01
4	gender:looks	2	36	3944.1	883	8.04e+01	5.23e-14	*	4.45e-01
6	gender:personality	2	36	4420.1	1274	6.24e+01	1.97e-12	*	4.74e-01
7	looks:personality	4	72	4055.3	1993	3.66e+01	1.10e-16	*	4.52e-01
8	gender:looks:personality	4	72	2669.7	1993	2.41e+01	1.11e-12	*	3.52e-01

- Mauchly's Test überall nicht signifikant, also Sphärizität gegeben
- Bei *gender* Effekt nicht signifikant → Bei Ignorieren von *personality* und *looks* kein signifikanter Unterschied
- Signifikanter Effekt bei *looks* → Bei Ignorieren von *personality* und *gender* signifikanter Unterschied bei *looks*
- Signifikanter Effekt bei *gender:looks* → Effekt bei *looks* verschieden je nach *gender*
- Signifikanter Effekt bei *gender:looks:personality* → Der signifikante Effekt bei *looks:personality* ist verschieden je nach *gender*

→ Analog bei anderen (und umgekehrten) Kombinationen

Zusammenfassung

- Gemischte ANOVA: Experiment durch Veränderung (mindestens) einer abhängigen und einer unabhängigen Variable
- Schritte
  - → 1 Dateneingabe und -Exploration
  - → 2 Kontraste erstellen und Modell berechnen
  - → 3 Auswerten und ggfalls weitere Auswertung mittels paarweiser t-Tests (gezielt, Kontrastierung) oder per Post Hoc Test (explorativ)
- Übersprungen: Robust (Wilcox, 2005), Gemischtes Design als Lineares Modell/Regression (Siehe Begleitmaterial im Moodle)
- Lineares Modell/Regression flexibler einsetzbar, erlaubt genauere Analysen der Interaktion und kommt ohne Bedingung der Sphärizität aus