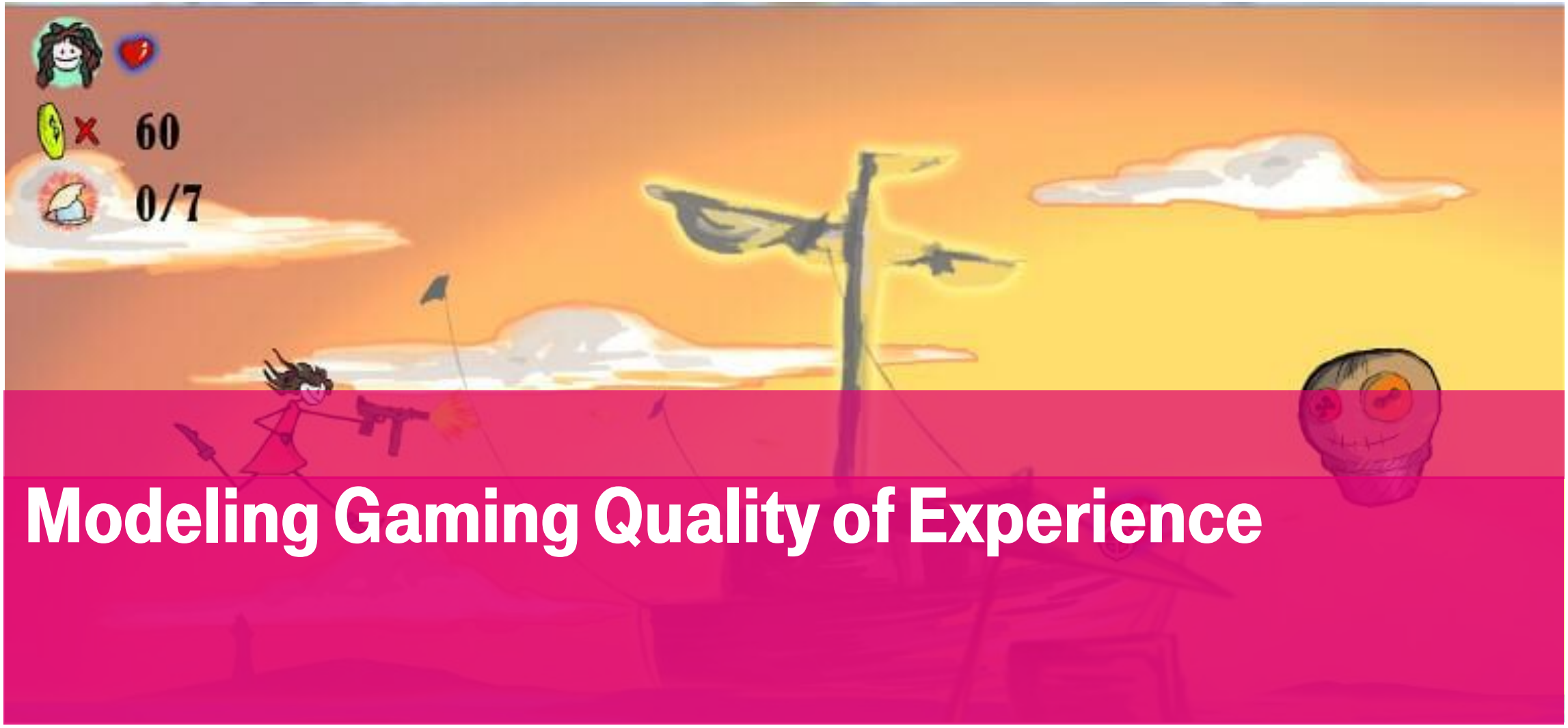


Modeling Gaming Quality of Experience

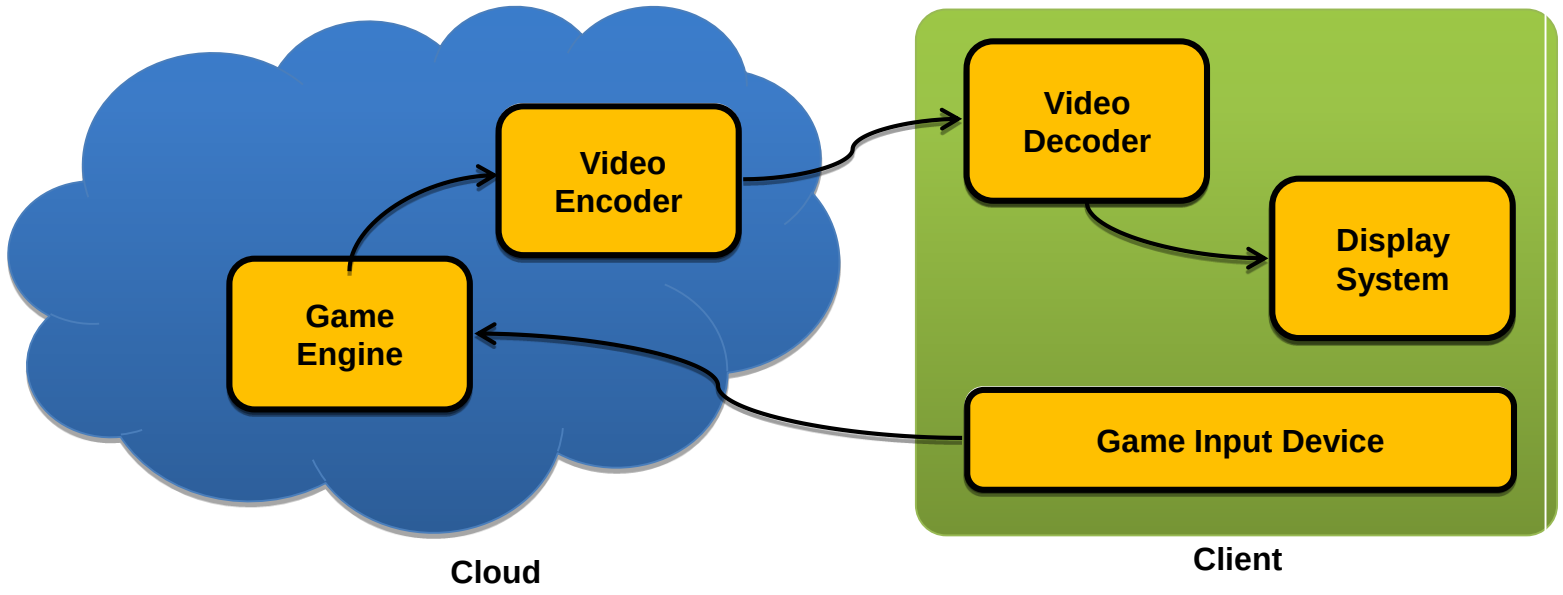
STREAMING VIDEO GAMES

- **Twitch TV**
  - 4th in Peak US Internet Traffic [1]
  - Ahead of Hulu, Facebook, Valve, and Amazon, among others
  - 100 million visitors per month in 2015
  - End users stream the gameplay and twitch then broadcast that

[1]. https://blog.twitch.tv/twitch-is-4th-in-peak-us-internet-traffic-90b1295af358

CLOUD GAMING

- The main bottleneck is the delay.



ITU ACTIVITIES

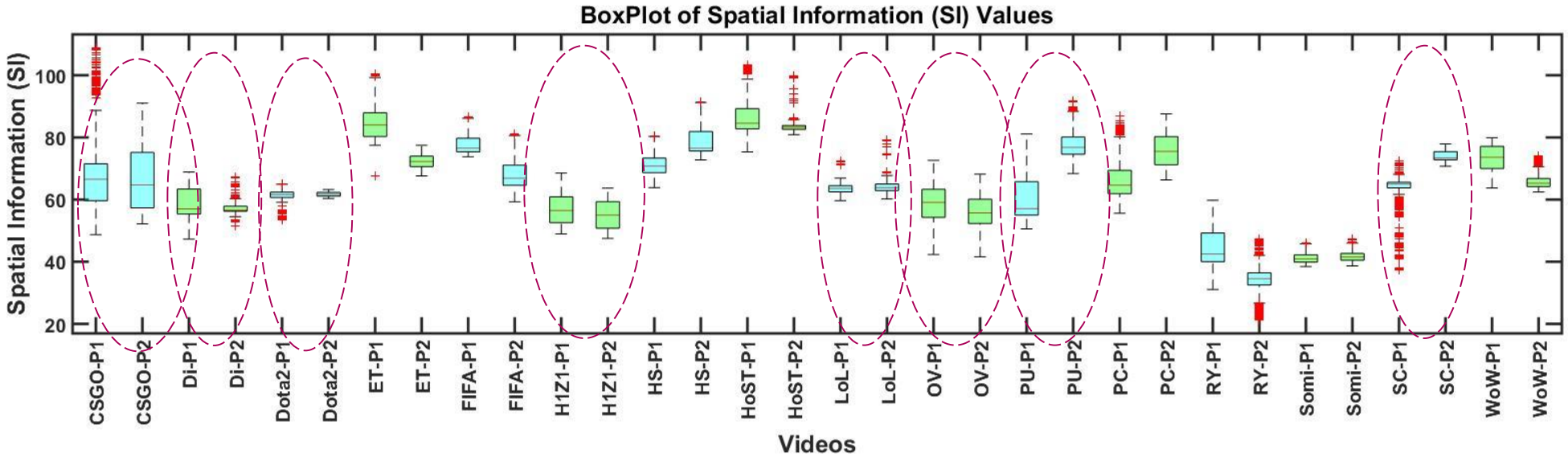
- 3 work items in study group 12:
  - ITU-T –G.1032: Factors affecting QoE in gaming applications (Q.13/SG12)
  - ITU -T -P.GAME: Subjective testing methodology (Q7/SG12)
  - ITU-T –G.OMG Opinion model for gaming applications (Q13/SG12)

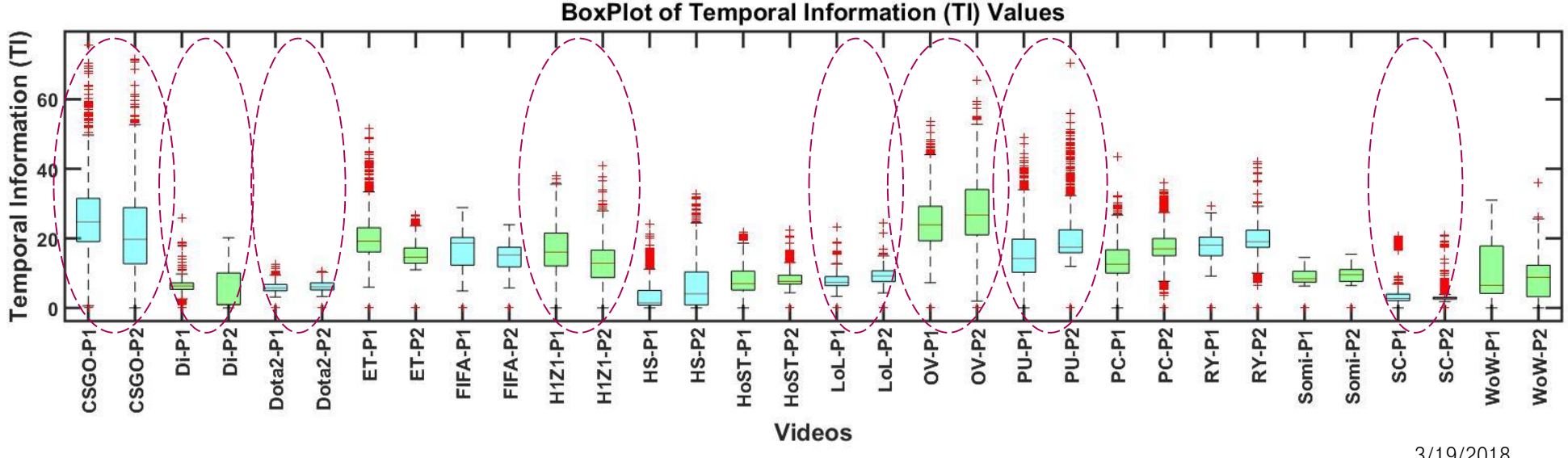
GAME CHARACTERISTICS

- Game is a **rule-based** system that has special characteristics.
- Usually games have a few **feedback elements** that communicate the details about the game's inner states.
- **Field of view** (FoV) in a video game plays an important role in video complexity.
- **Size of game world** can dramatically affect coding strategy.
- A game is usually constructed from a **pool of predesigned objects** which result in different level of details.

DATA SET

- 16 video games, each two raw video sequences of 30 sec, with resolution of 1080p and 30 fps.
- Encoded into 3 Resolutions, and 4 bitrates (one pass, CBR) both H.265 and H.264.
  - Resolutions: 1080, 720, 480
  - Bitrate: 500, 1000,1500, 2000, 3000, 4000, 10000.


BoxPlot of Spatial Information (SI) Values
Spatial Information (SI)
20
40
60
80
100
CSGO-P1
CSGO-P2
Di-P1
Di-P2
Dota2-P1
Dota2-P2
ET-P1
ET-P2
FIFA-P1
FIFA-P2
H1Z1-P1
H1Z1-P2
HS-P1
HS-P2
HoST-P1
HoST-P2
LoL-P1
LoL-P2
OV-P1
OV-P2
PU-P1
PU-P2
PC-P1
PC-P2
RY-P1
RY-P2
Somi-P1
Somi-P2
SC-P1
SC-P2
WoW-P1
WoW-P2
Videos


BoxPlot of Temporal Information (TI) Values
Temporal Information (TI)
0
20
40
60
CSGO-P1
CSGO-P2
Di-P1
Di-P2
Dota2-P1
Dota2-P2
ET-P1
ET-P2
FIFA-P1
FIFA-P2
H1Z1-P1
H1Z1-P2
HS-P1
HS-P2
HoST-P1
HoST-P2
LoL-P1
LoL-P2
OV-P1
OV-P2
PU-P1
PU-P2
PC-P1
PC-P2
RY-P1
RY-P2
Somi-P1
Somi-P2
SC-P1
SC-P2
WoW-P1
WoW-P2
Videos

MAD ANALYSIS

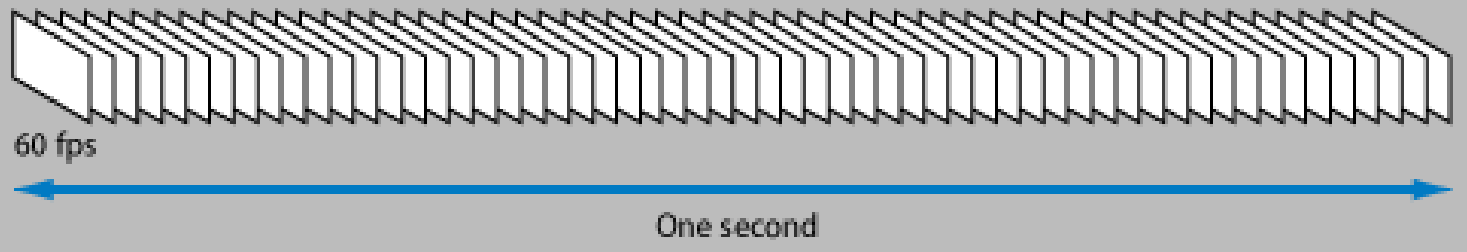
- Mean Average Difference (MAD) has been used in h.264 for video complexity estimation as calculated as follow:

$$MAD = \sum_{i,j} |residual(i,j)| = \sum_{i,j} |source(i,j) - prediction(i,j)| \Big)$$

MAD ANALYSIS

- Mean Average Difference (MAD) has been used in h.264 for video complexity estimation as calculated as follow:

PARTIAL PSNR/SI/TI

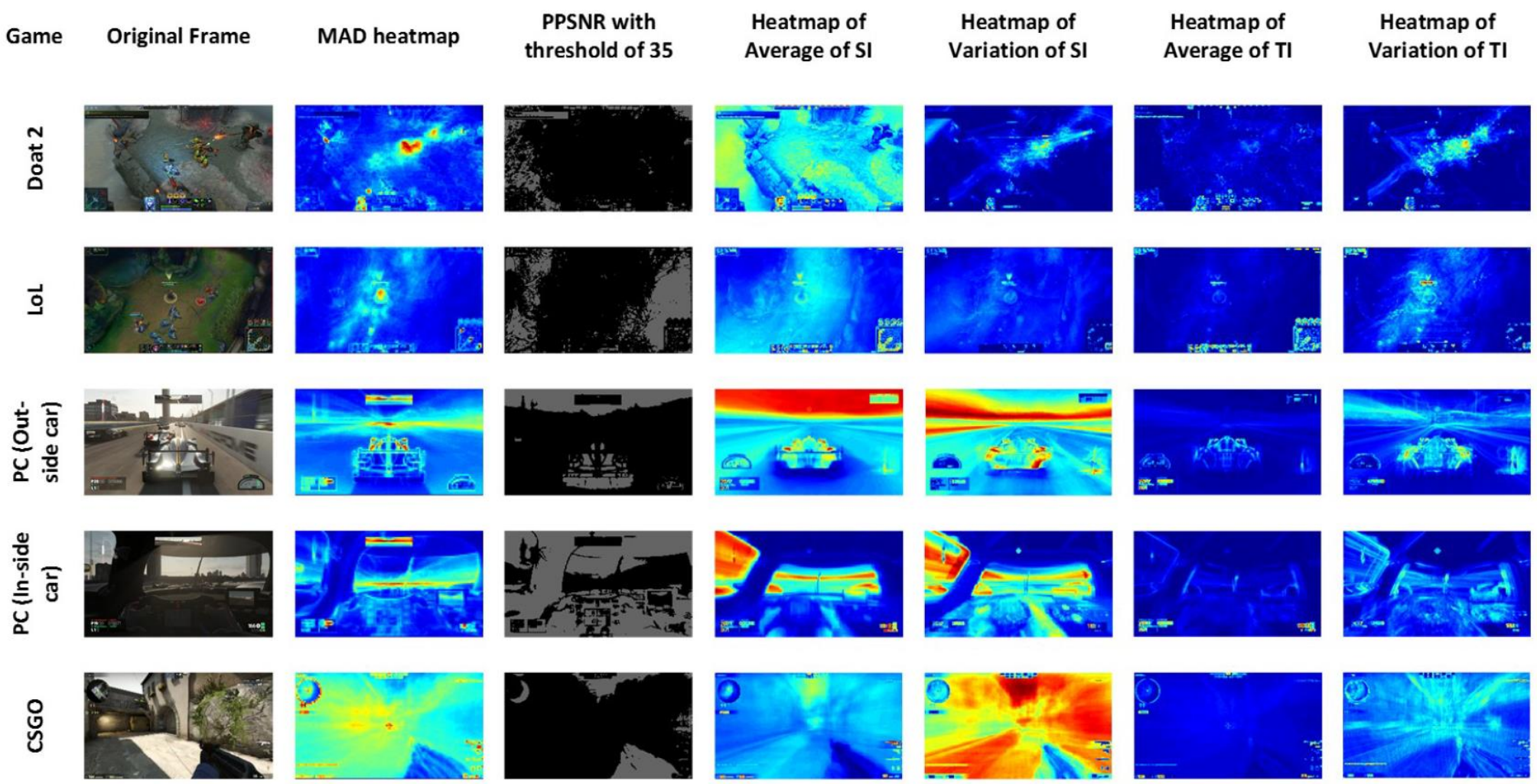


Average and variance of PSRN, SI and TI over 30 seconds?

Is there a pattern for a specific game?

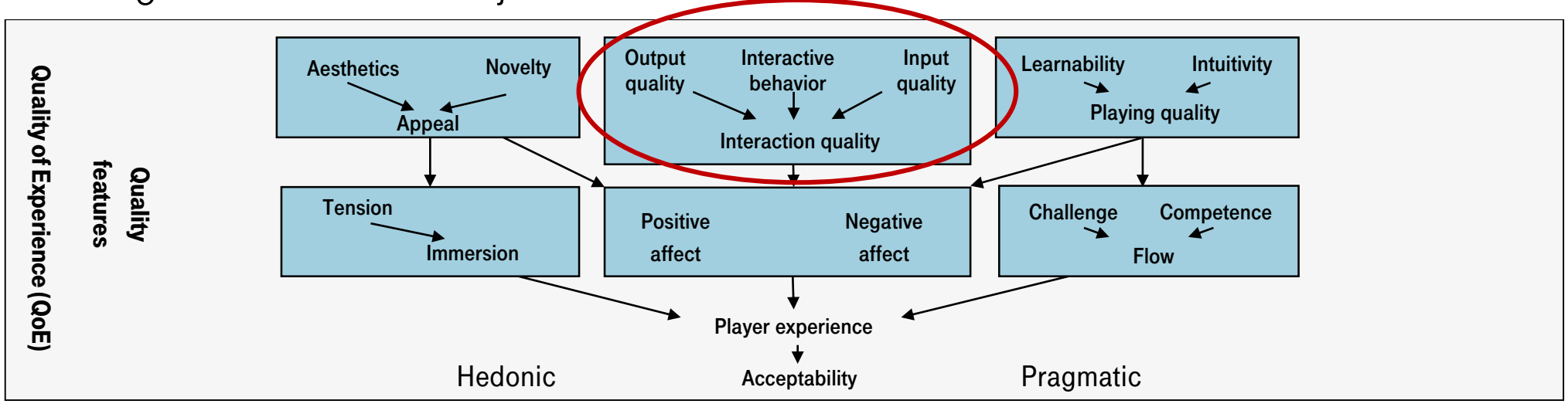
How that could affect the quality assessment?

SPATIAL AND TEMPORAL FEATURES



GAMING QUALITY. TAXONOMY.

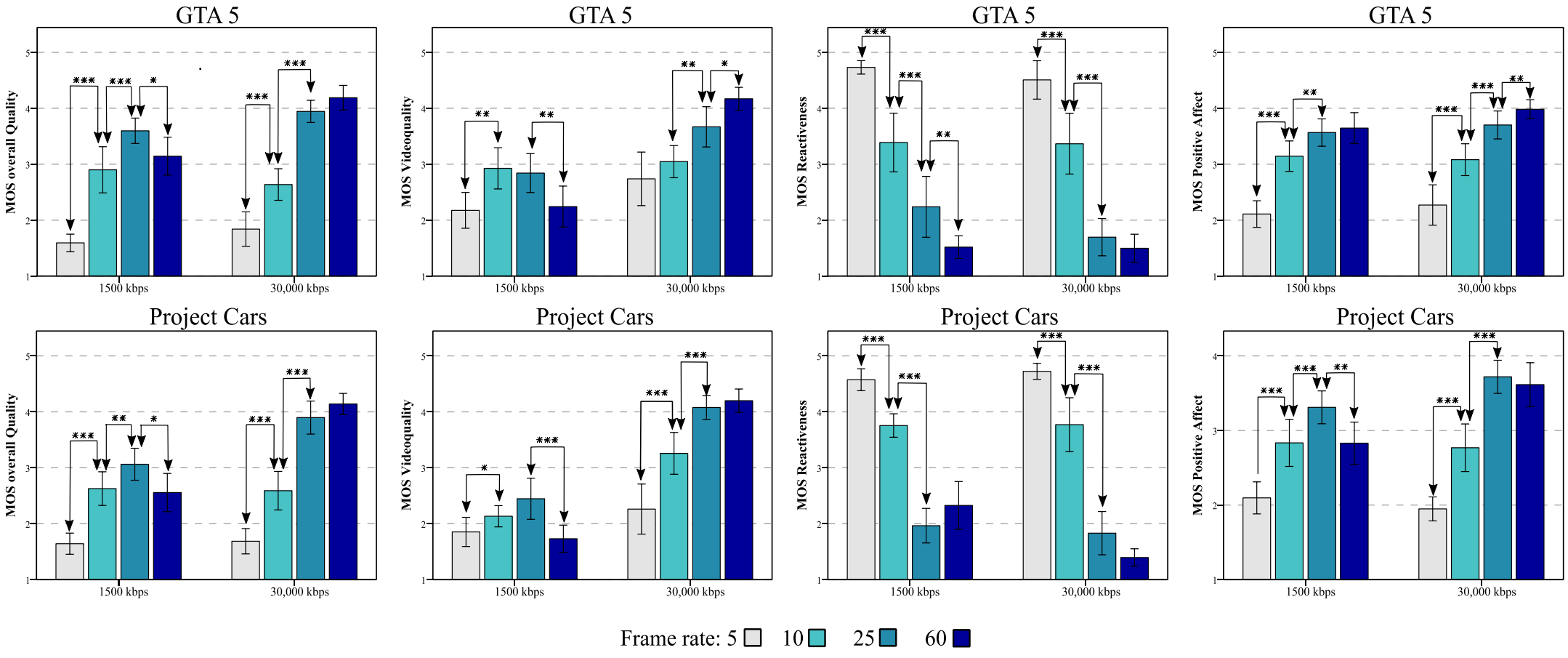
- Modeling the effect of video degradation on quality features.
- Design a study to get some insight:
  - Bitrate (1,5 and 30 Mbps)
  - Frame rate (10, 15, 25, 60)
  - Two games: GTA and Project Cars



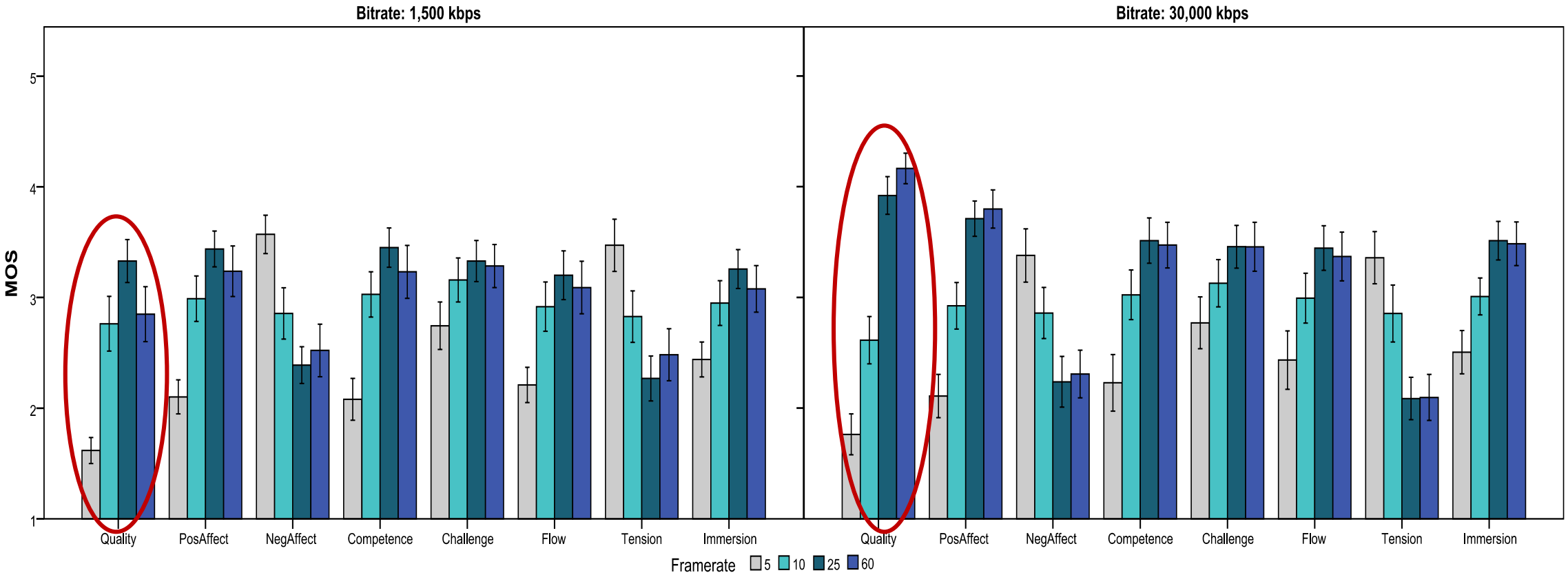
STRUCTURAL QOE MODELING

GTA

Project Cars



STRUCTURAL QOE MODELING



STRUCTURAL QOE MODELING

- Relation between overall quality and quality features:

$$MOS = 1.102 + 0.59 \cdot PosAffect + 0.24 \cdot Reactiveness + 0.25 \cdot VideoQuality$$

$$Reactiveness = \exp(0.84 + 4.43/\text{Framerate})$$

$$I\_coding = 3.52 + \text{-}0.094 \cdot BR + \text{-}0.062 \cdot FR$$
$$+0.00063 \cdot BR\text{^}2 + 0.00115 \cdot FR\text{^}2 + \text{-}0.00017 \cdot BR \cdot FR$$

MODELING GAMING QOE

Video quality model	• No reference metric • Bit stream model
Reactiveness	• Classifying games based on their sensitivity to delay. • Considering variation of delay.
Quality dimensions	• Positive affect and flow are two main candidates.

Any question?