Valuing On-the-Ball Actions in Soccer

A Critical Comparison of xT and VAEP

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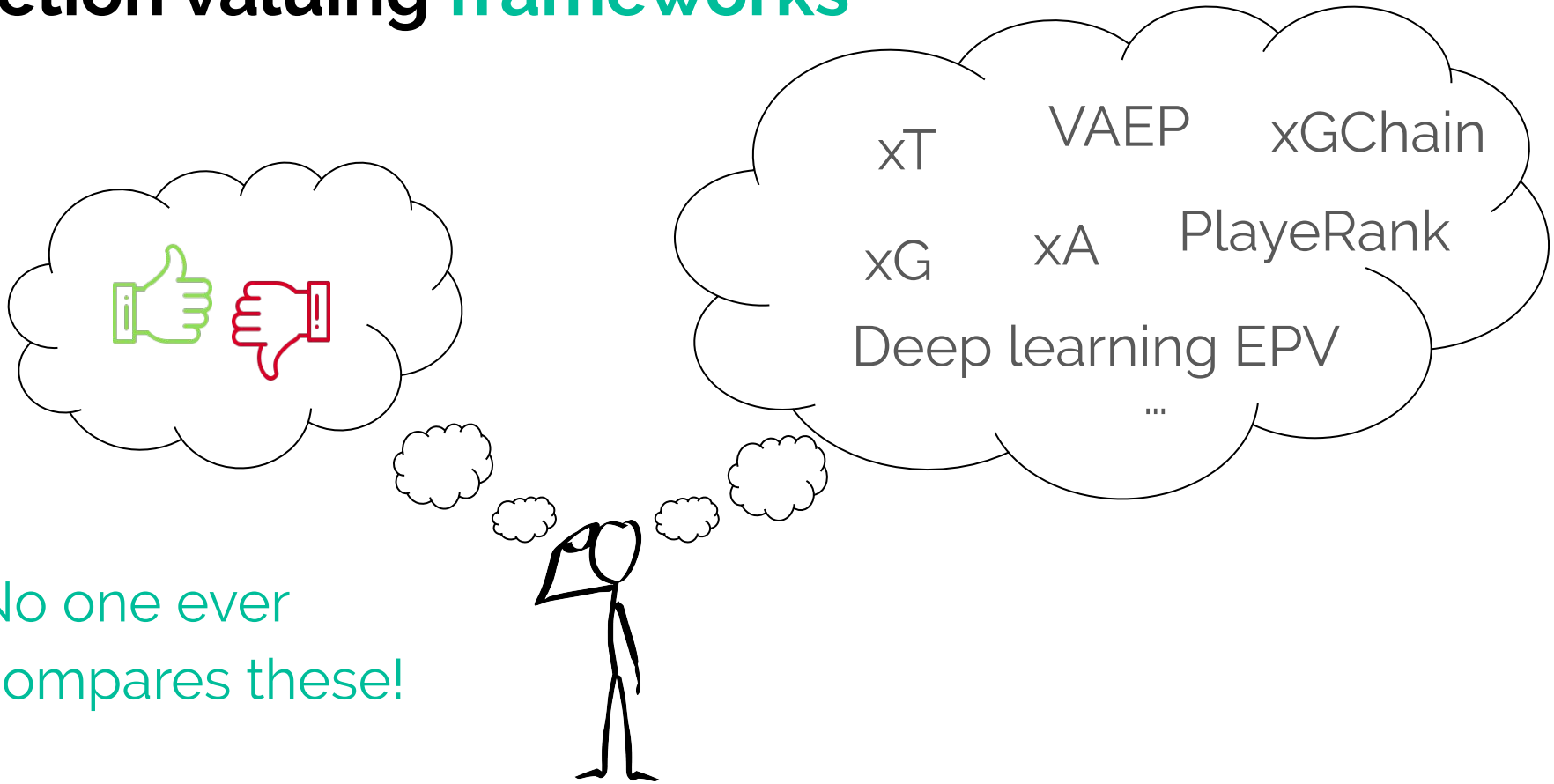
What is the value of a player's actions?

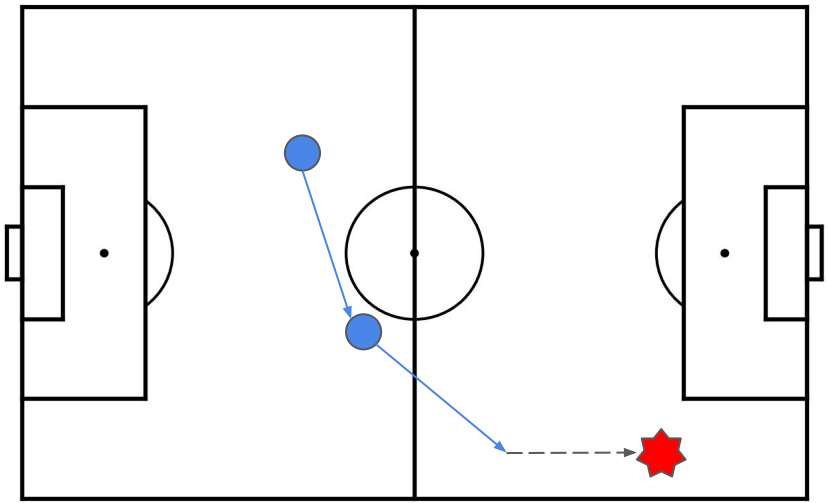
Action valuing frameworks



No one ever
compares these!

Goal of this work: Compare xT and VAEP

Value actions in event stream data



Type	Player	Time	Result	Start	End
Pass	..	2'34	Success	X=40, Y=24	X=45, Y=44
Pass	..	2'36	Success	X=45, Y=44	X=64, Y=66
Dribble	..	2'38	Success	X=64, Y=66	X=85, Y=66
Tackle	..	2'40	Fail	X=85, Y=66	X=85, Y=66

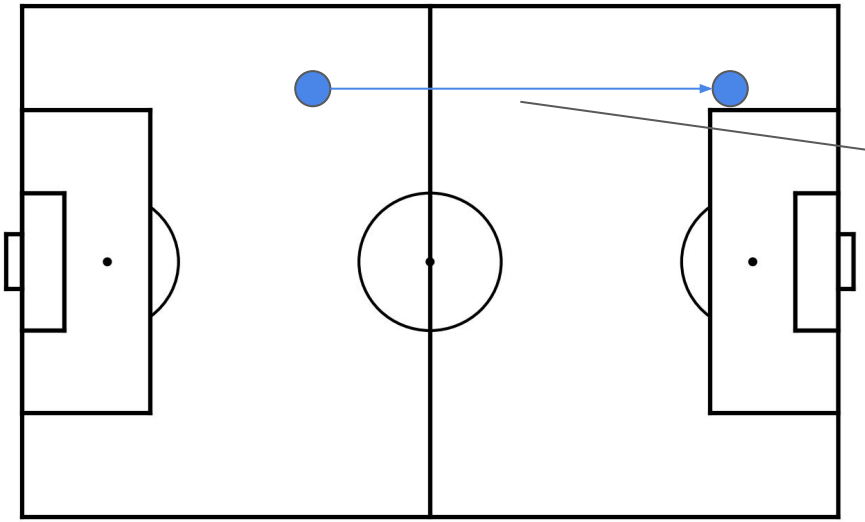
Action a_i moves the game
from state S_{i-1} to state S_i

a_i

S_{i-1}

S_i

Game states receive values



$$V(a_i) = Q(S_i) - Q(S_{i-1})$$

Difference between values of consecutive game states

Two questions for action valuing frameworks:

- How are game states represented?
- How are game states valued?

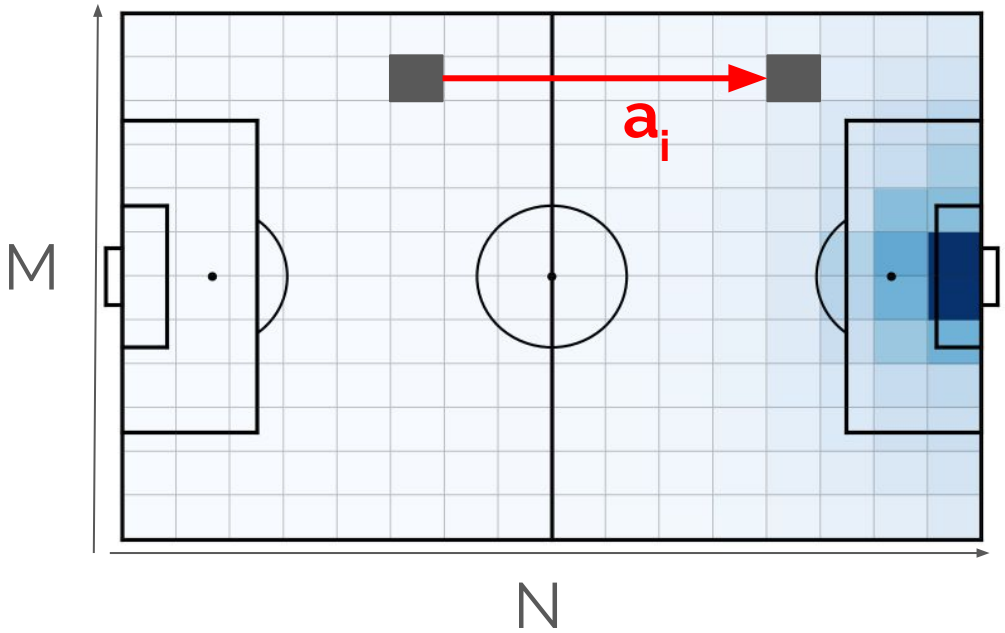
Next: How is this tackled by xT and VAEP?

Expected Threat (xT) - Karun Singh

https://karun.in/blog/expected-threat.html

xT: Game state representation

Possession-based Markov model values ball-progressing actions



$$xT_{value}(a_i) = Q(S_i) - Q(S_{i-1})$$

$xT(a_{i,end})$ $xT(a_{i,start})$

xT: Value of a game state

shoot

move

$$xT(z) = s_z * xG(z) + m_z * \sum_{z'=1}^{M*N} T_{z \to z'} * xT(z')$$

Dynamic programming

System of linear equations

Valuing Actions by Estimating Probabilities (VAEP) - Decroos et al. (KDD 2019)

VAEP: Intuition

Value game state by expected impact on score:

(1) Increases short-term prob. of team T scoring

(2) Decreases short-term prob. of team T conceding

$$VAEP_{value}(a_i) = Q(S_i) - Q(S_{i-1})$$

$$Q(S_i) = P^k_{scores}(S_i, T) - P^k_{concedes}(S_i, T)$$

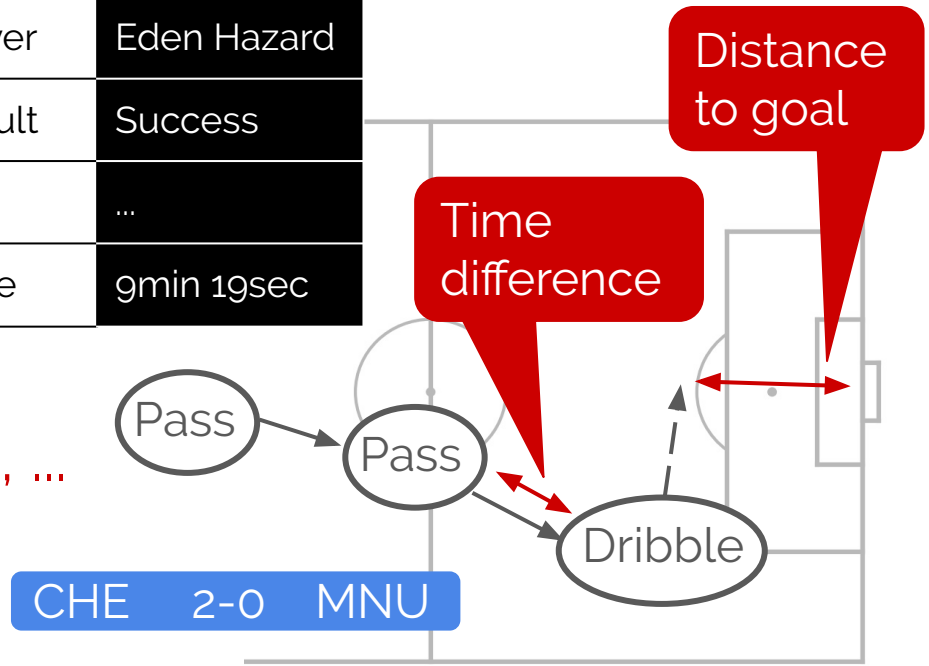
VAEP: Features that describe game state S_i

a) Simple features
   - Action type
   - Result, ...

b) Complex features
   - Distance to goal
   - Time between actions, ...

c) Context features
   - Goal difference, ...

Type	Pass
Player	Eden Hazard
Result	Success
...	...
Time	9min 19sec



VAEP: Value of a game state

X: Features

Y: Labels

1 if team T scores/concedes in next *k* actions

F: Probabilistic classifier

Eg. XGBoost

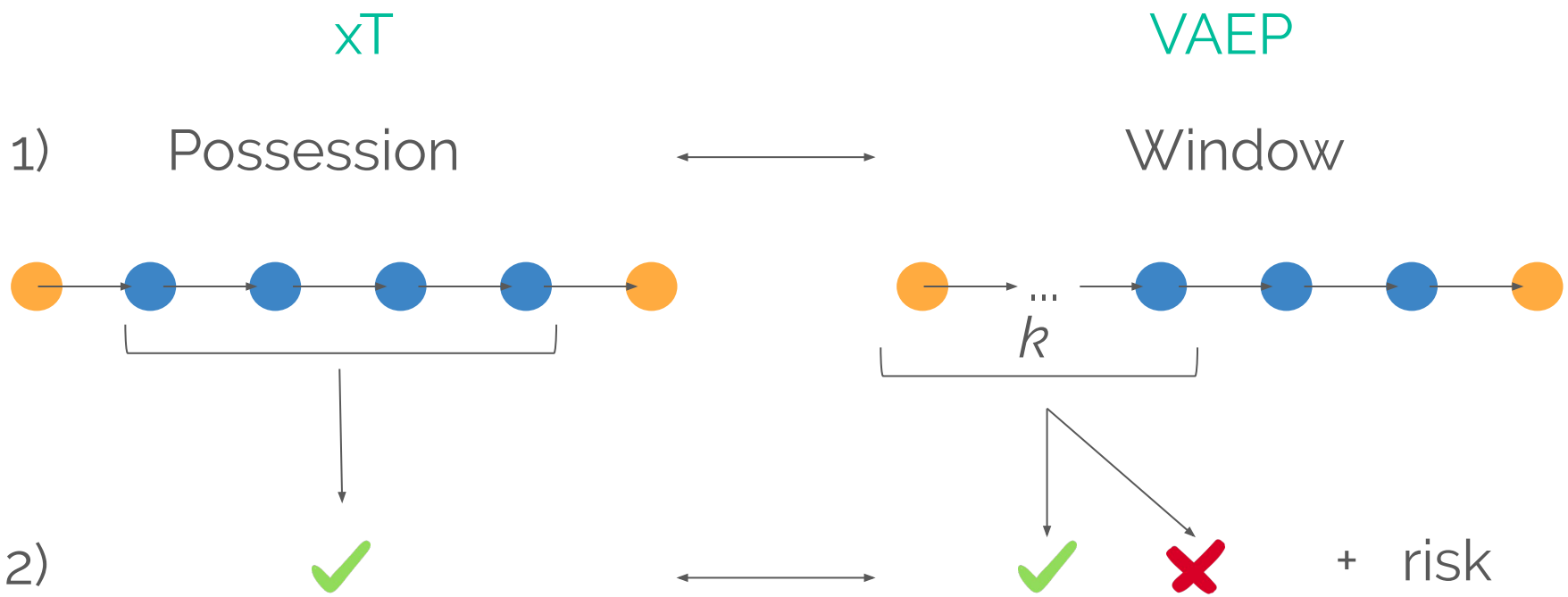
Let's talk about the differences between xT and VAEP

- due to game state representation (3)
- due to action sequences looked at (2)

Differences due to the game state representation

xT		VAEP
1) Limited game dynamics	⟷	Richer action + game context
2) Ball-progressing actions 	⟷	All actions 
3) Interpretable	⟷	Explanation not straightforward

Differences due to the action sequences looked at



Four illustrative examples to compare the action values

- (risky) backward passes
- set up counter attacks
- forward dribble into penalty box
- through ball near penalty box

Datasets used

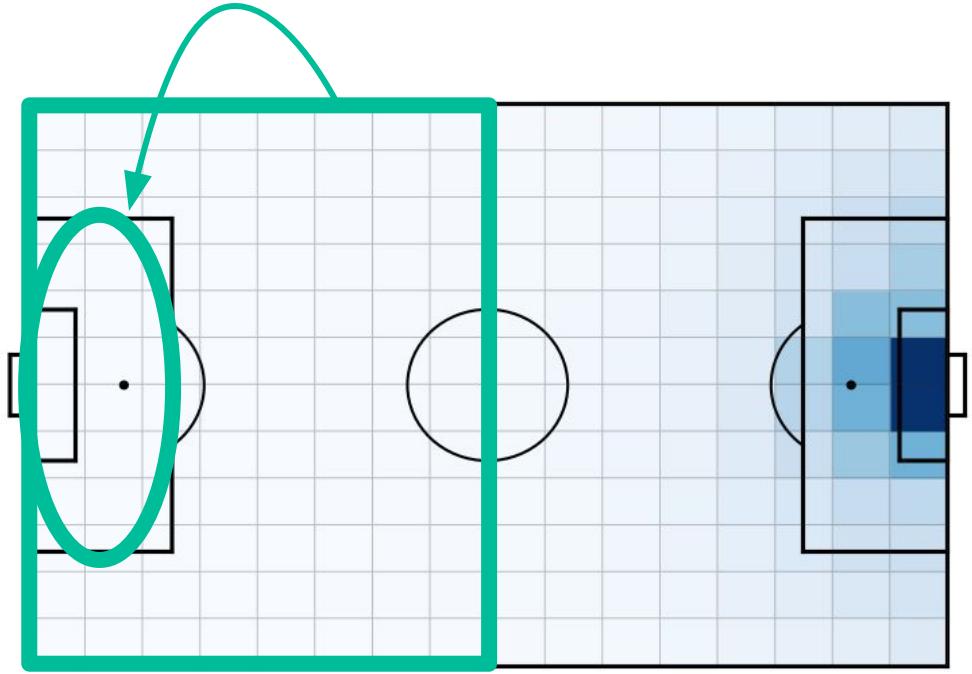
STATSBOMB
INSIDE EVERY PASS, EVERY SHOT, EVERY MOVE

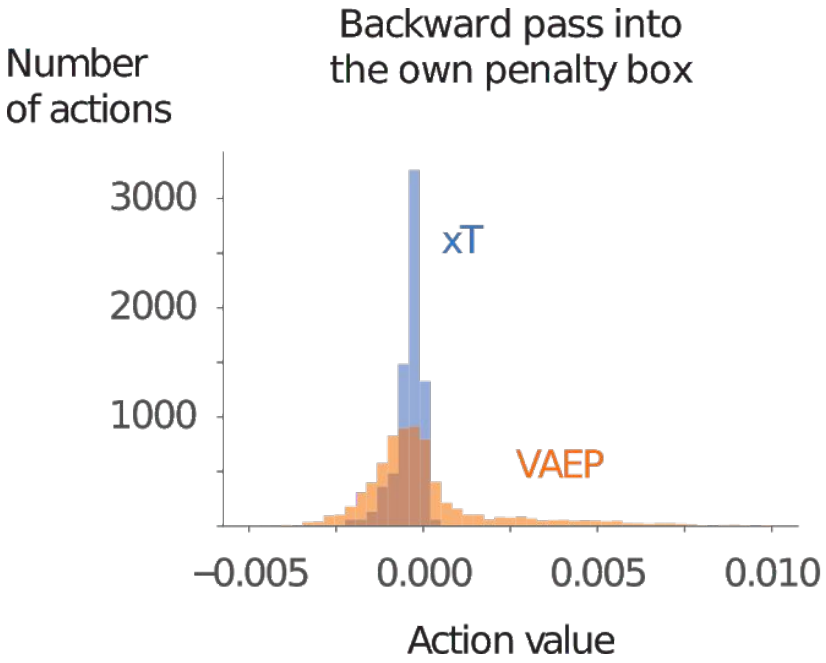
Models trained on 2017/2018 English Premier League

Models tested on 2018/2019 English Premier League

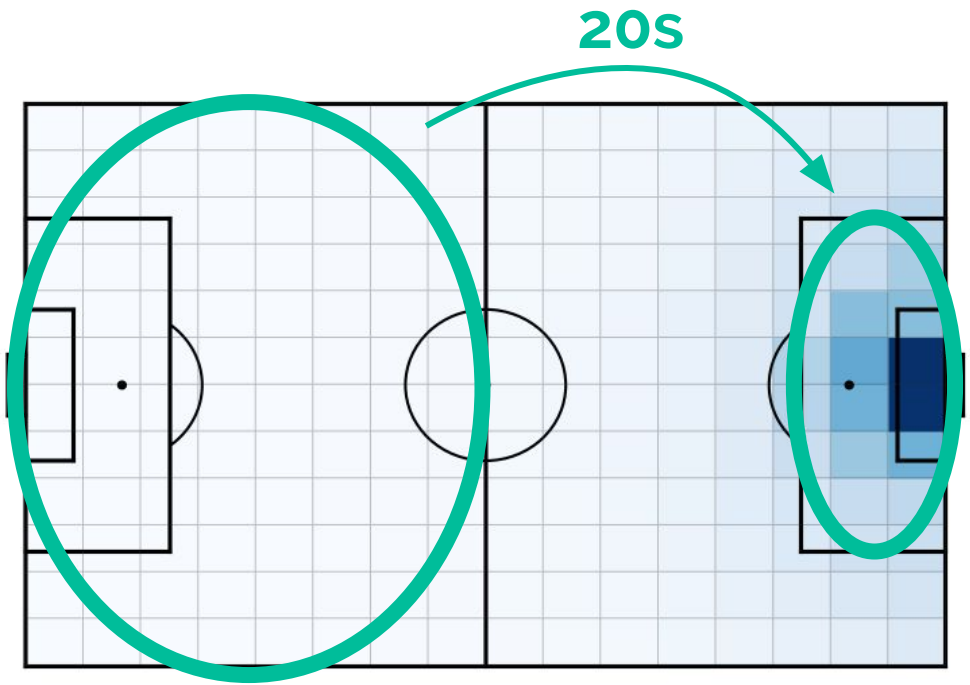
SPADL-format

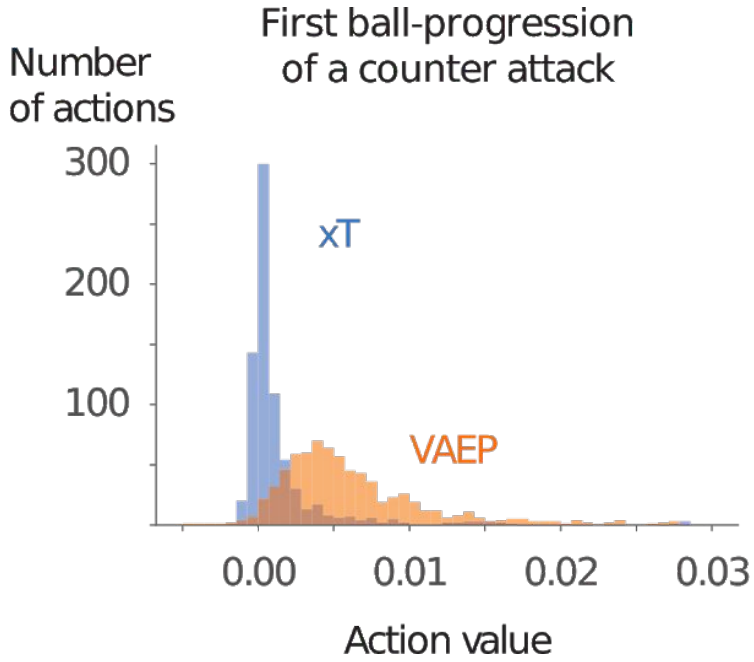
VAEP assigns more diverse values to “risky” backward passes



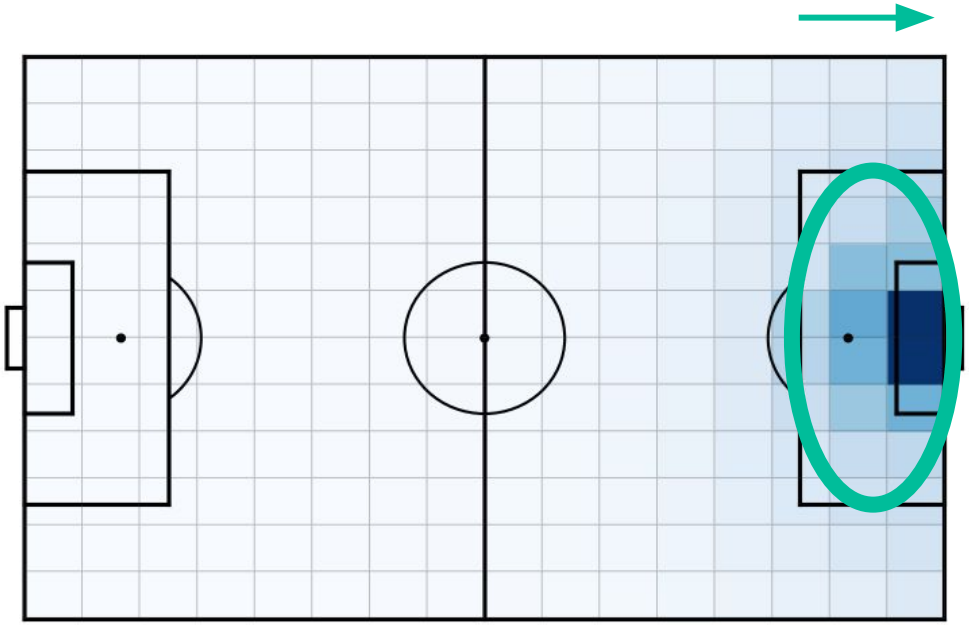


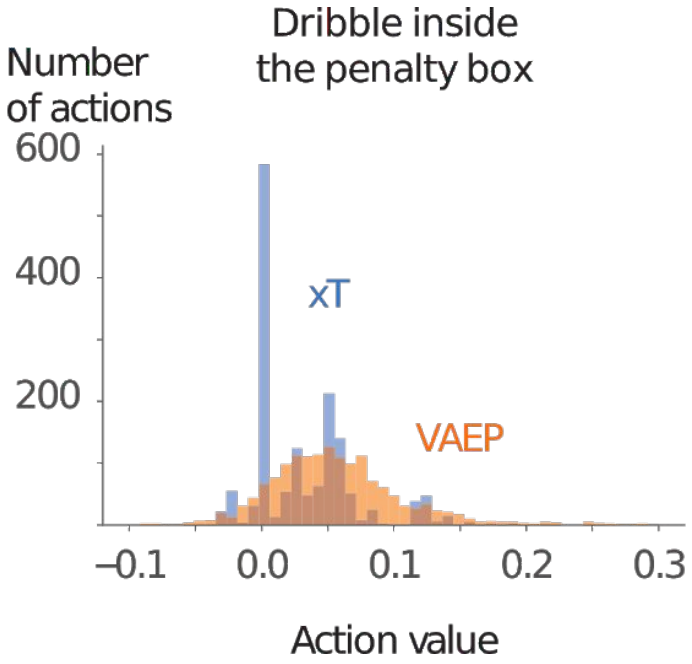
VAEP generally assigns higher values to 1st ball progression of counter attacks



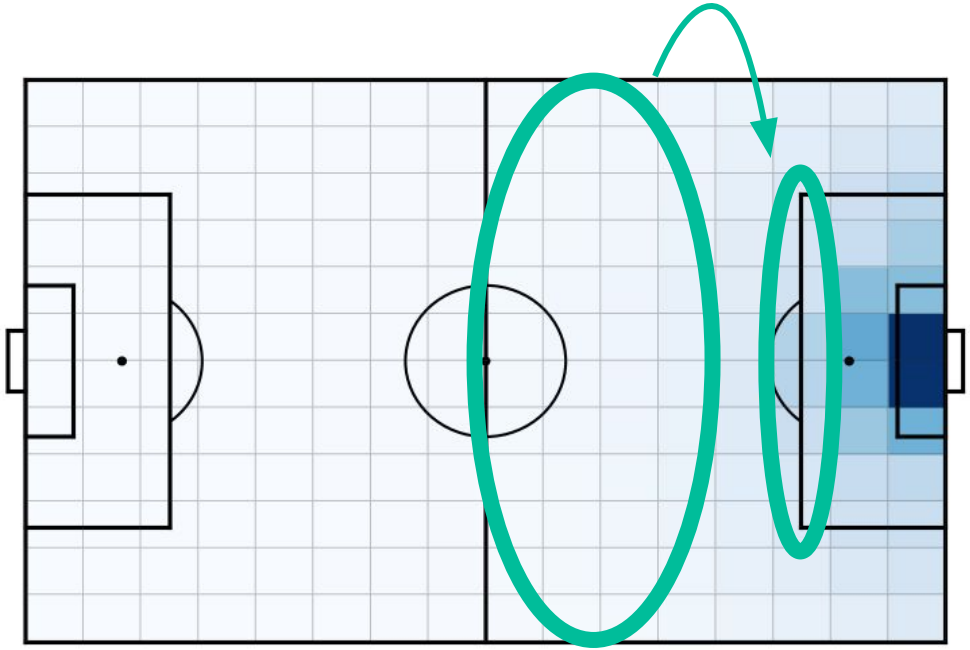


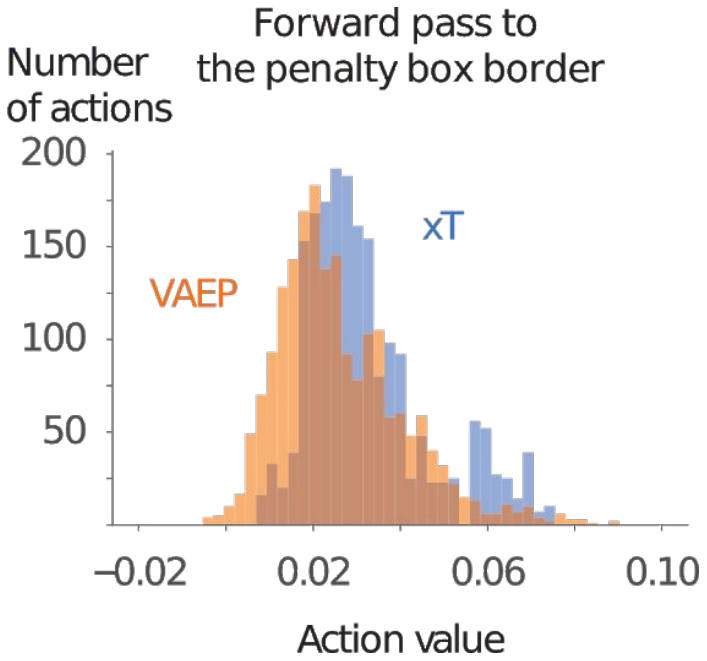
Short forward dribbles inside penalty box are not valued by xT





xT values through balls higher than VAEP



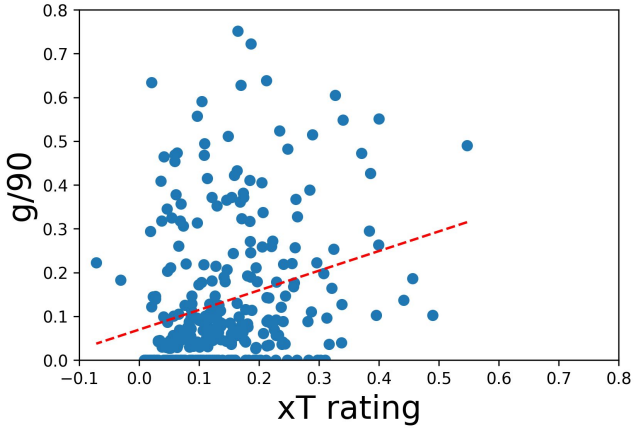


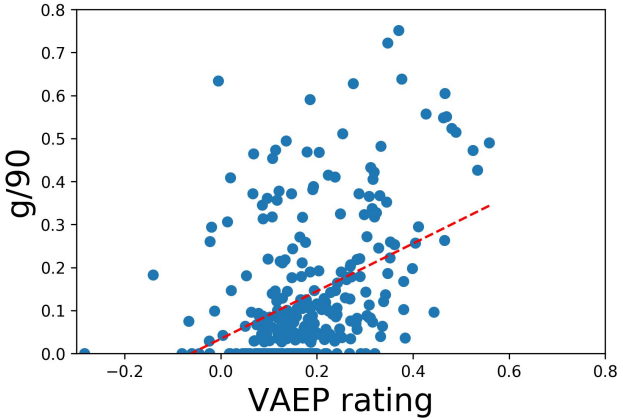
Comparing player ratings (>=900min)

- Compare with traditional player metrics
- Top 25 players
- Robustness of the rating systems

Both show differences to traditional metrics

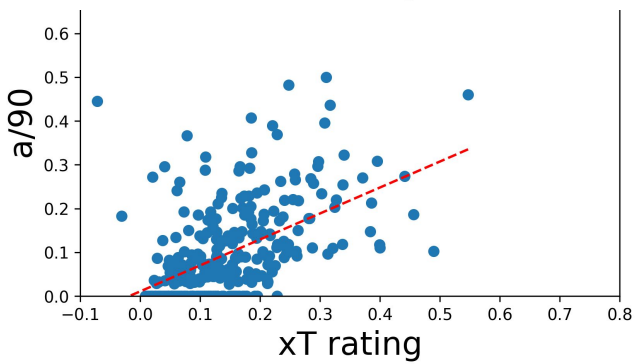
ρ = 0.26

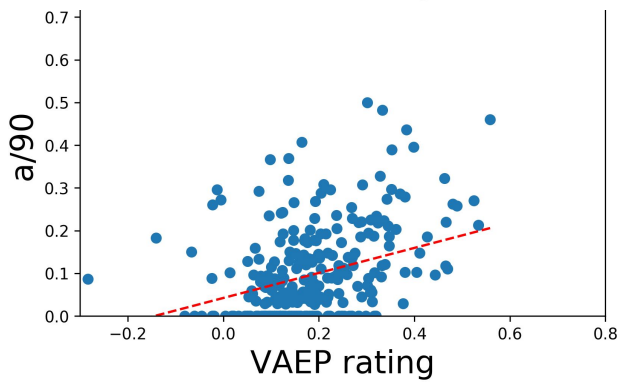




ρ = 0.41

ρ = 0.53





ρ = 0.33

EPL 18/19

1	Eden Hazard	=	1
2	Adama Traoré	▼	16
3	Kevin De Bruyne	▼	24
4	Alex Iwobi	▼	25
5	Anthony Martial	▼	6
6	Felipe Anderson	▼	8
7	Alexis Sánchez	▼	106
8	Gerard Deulofeu	▲	2
9	Wilfried Zaha	▼	12
10	Riyad Mahrez	▲	3

xT

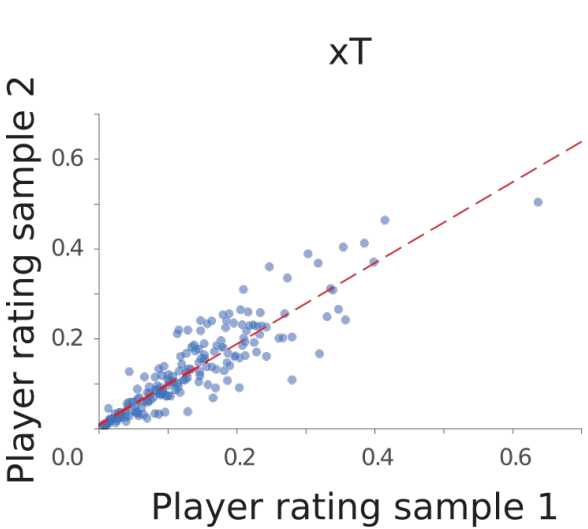
1	Eden Hazard	=	1
2	Gerard Deulofeu	▼	8
3	Riyad Mahrez	▼	10
4	Xherdan Shaqiri	▼	24
5	Son Heung-Min	▼	47
6	Anthony Martial	▲	5
7	Mohamed Salah	▼	14
8	Felipe Anderson	▲	6
9	Raheem Sterling	▼	11
10	Jonjo Shelvey	▼	18

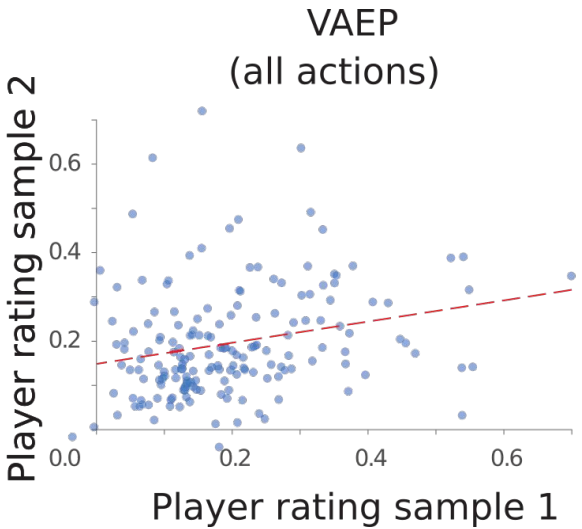
VAEP

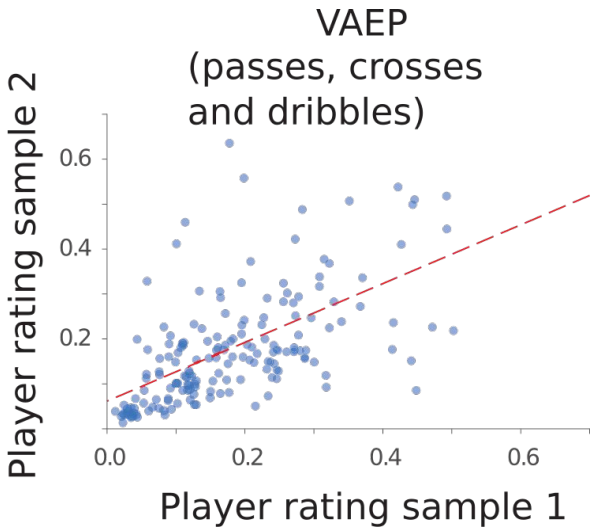
Robustness

Intuition: few outstanding actions should not alter assessments dramatically: correlation on different samples

xT is more robust







Conclusions

Conceptual, qualitative and quantitative comparison of xT and VAEP

Differences due to game state representation and actions valued

- VAEP risk-reward tradeoff
- xT more robust
- Rankings deviate

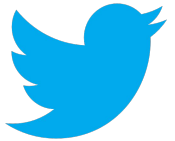
} Additional insight!

Online resources

https://github.com/ML-KULeuven/socceraction/

- VAEP + xT
- pip install socceraction

https://dtai.cs.kuleuven.be/sports



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Thank you!