

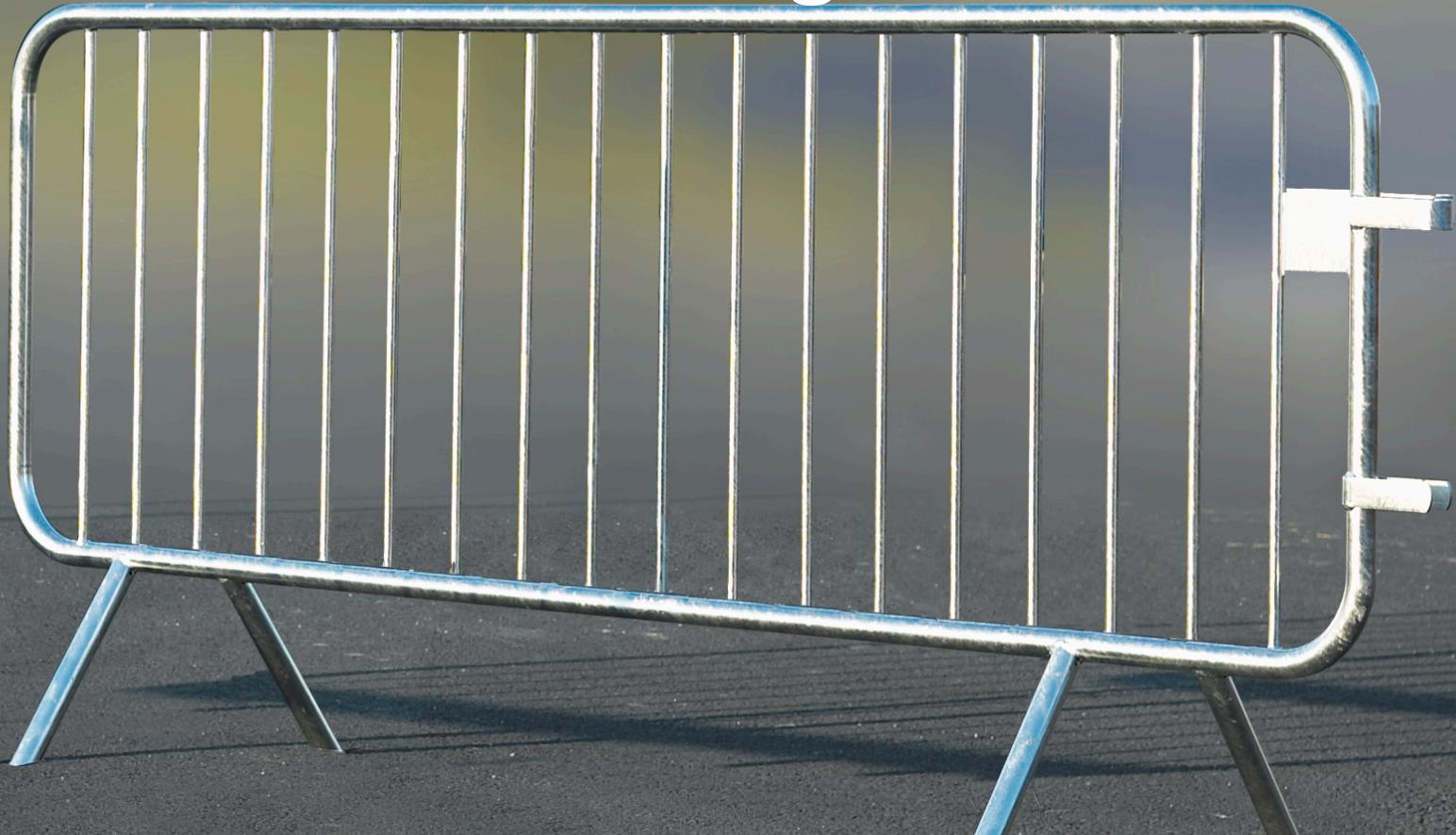
# The Magic Barrier of Recommender Systems: No Magic, Just ratings

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# What is the magic barrier?



## The Magic Barrier

The **upper bound** on recommendation accuracy

Recommendation accuracy is only as good as the **quality of the underlying data**

**Users are noisy / incoherent in their rating behavior**



# How to find the magic barrier?

1. Collect infinite re-ratings for each item from your users.
2. Find standard deviation of rating/re-rating inconsistencies (noise)  
[Said et al. UMAP '12]

Realistically, an infinite amount of re-ratings is not probable

Bitte bewerte diese Filme:

Schau dazu nicht deine Bewertungen auf moviepilot.de an!  
Keine Sorge, die Bewertungen auf dieser Seite haben keine Auswirkungen auf dein Profil bei moviepilot.de!

Schritt: 0 of 20

MISSING: IMPOSSIBLE

GREMLINS

BATMAN

TWISTER

THE BOURNE ULTIMATUM

WEG ZUM RHEIN

LUCKY SLEVIN

HOOK (1991)

NACHTS IM MUSEUM

A-TEAM

Weiter

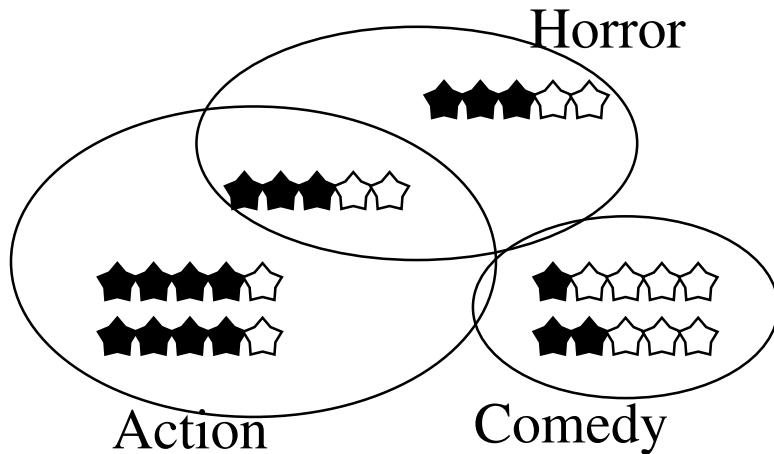
The interface displays a series of movie posters in a grid. Each poster is accompanied by a horizontal rating scale with a yellow slider. The first poster, 'MISSING: IMPOSSIBLE', has a rating of 3.5. The fifth poster, 'HOOK (1991)', has a rating of 6.0. The user's cursor is visible over the rating slider for 'HOOK'. The interface includes text instructions at the top, a progress bar, and a 'Weiter' button at the bottom right.

A close-up photograph of three zebras standing in a row, facing towards the right. Their black and white stripes are clearly visible against a blurred green and brown background.

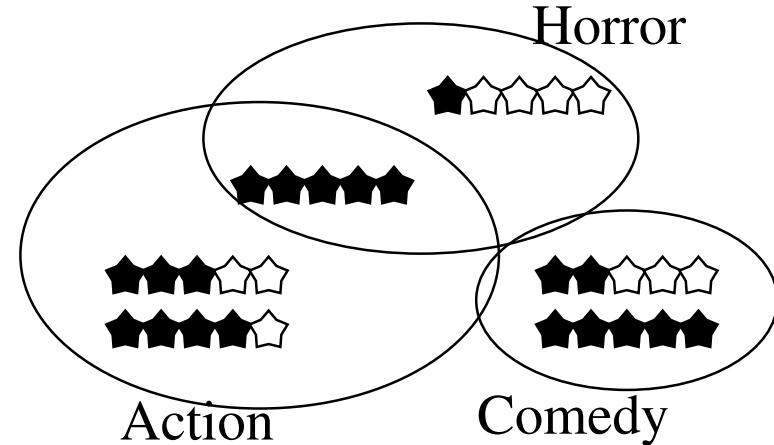
Coherence

# What is coherence?

Coherent user



Incoherent user



## Definition of Coherence

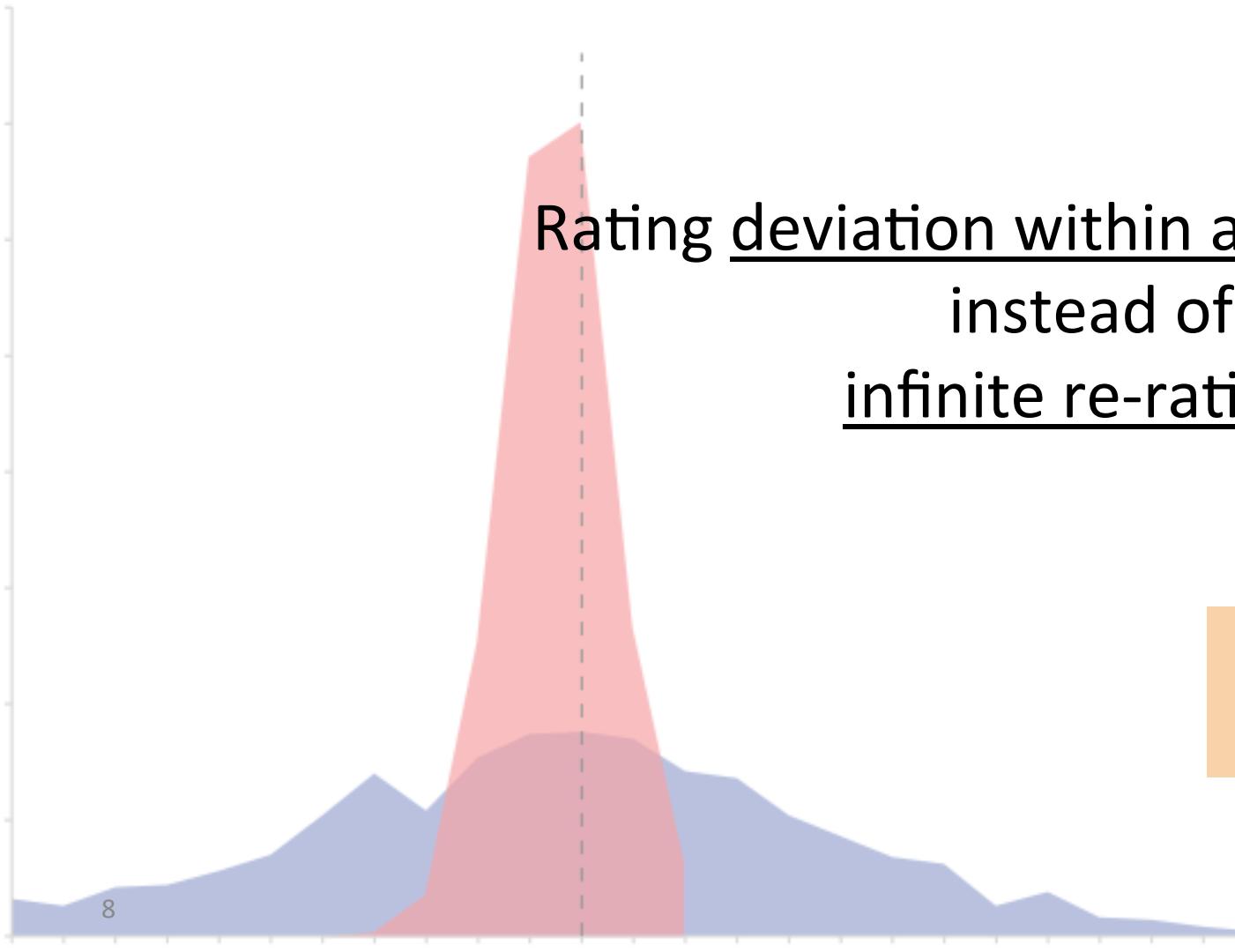
Rating consistency within a feature space (genres, themes, etc.)

$$c(u) = - \sum_{f \in F} \sigma_f(u)$$

Item features

$$\sigma_f(u) = \sqrt{\sum_{i \in I(u,f)} (r(u,i) - \bar{r}_f(u))^2}$$

User's rating deviation within a feature



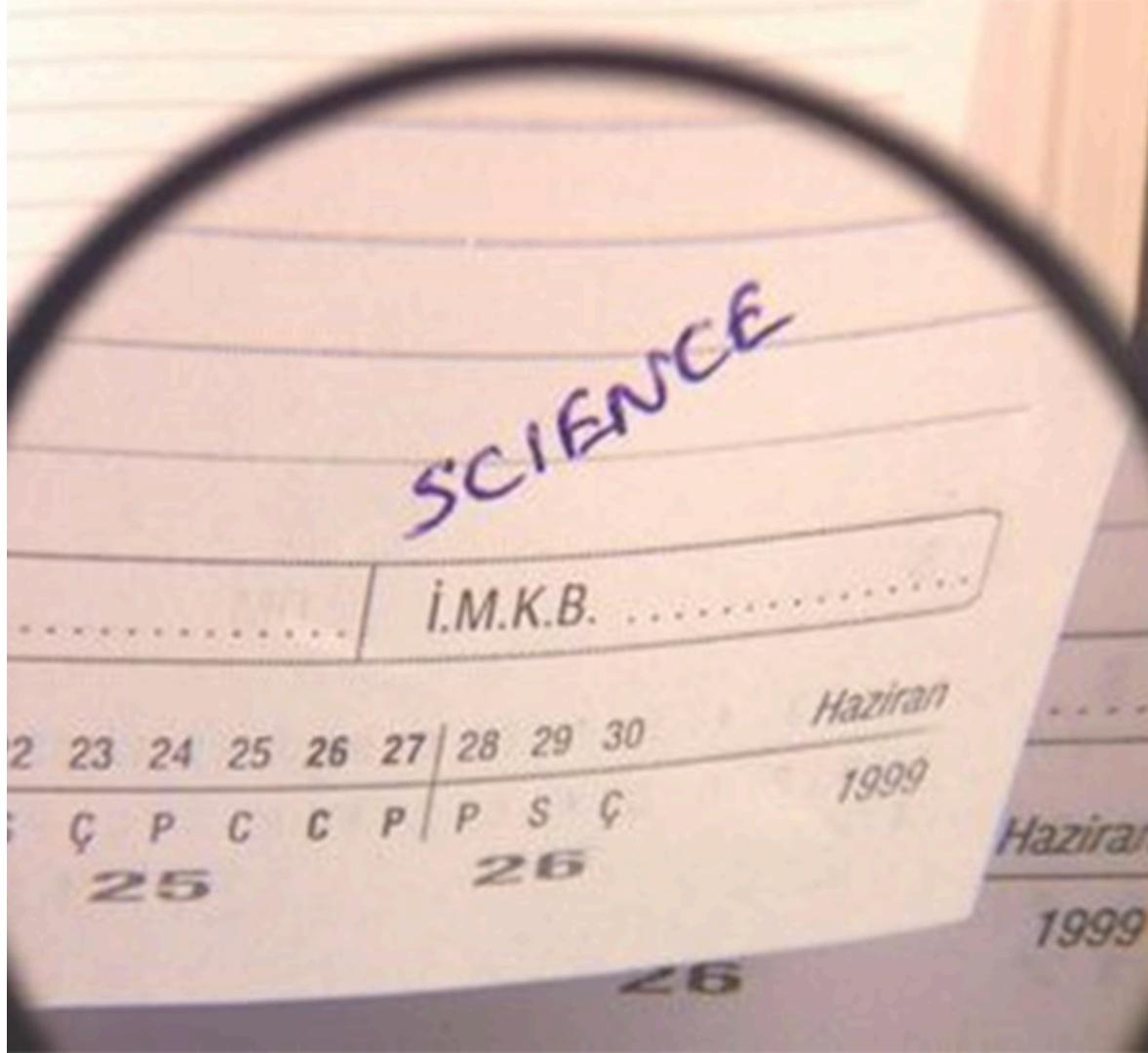
Rating deviation within a feature space  
instead of  
infinite re-ratings

Is this a good  
estimate of the  
magic barrier?

## Experiments

**EX1:** Is rating coherence a good predictor for the Magic Barrier?

**EX2:** Can we use rating coherence to improve recommendation results?  
Especially when we do not have re-ratings/magic barrier?



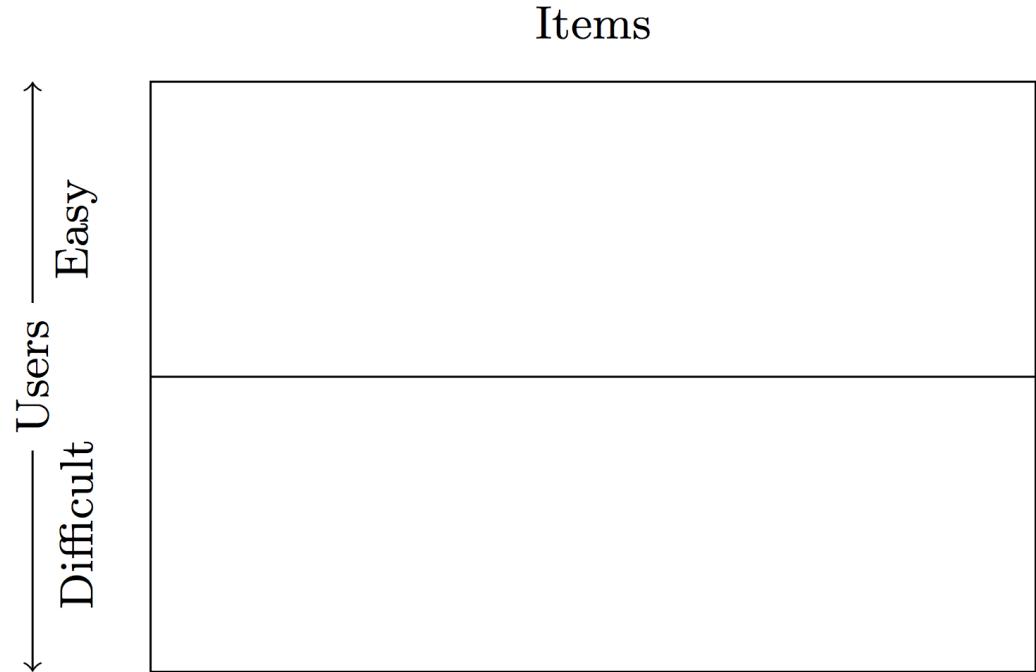
# Rating Coherence vs. Magic Barrier

Rank users according to magic barrier/  
rating coherence:

- High/low magic barrier
- Low/high rating coherence in the  
“genre” feature space

Find correlation (Spearman) between  
magic barrier/coherence ranking

\*Dataset from moviepilot.de, contains re-ratings  
from 306 users [Said et al. UMAP '12]



# Magic Barrier & Rating Coherence correlation

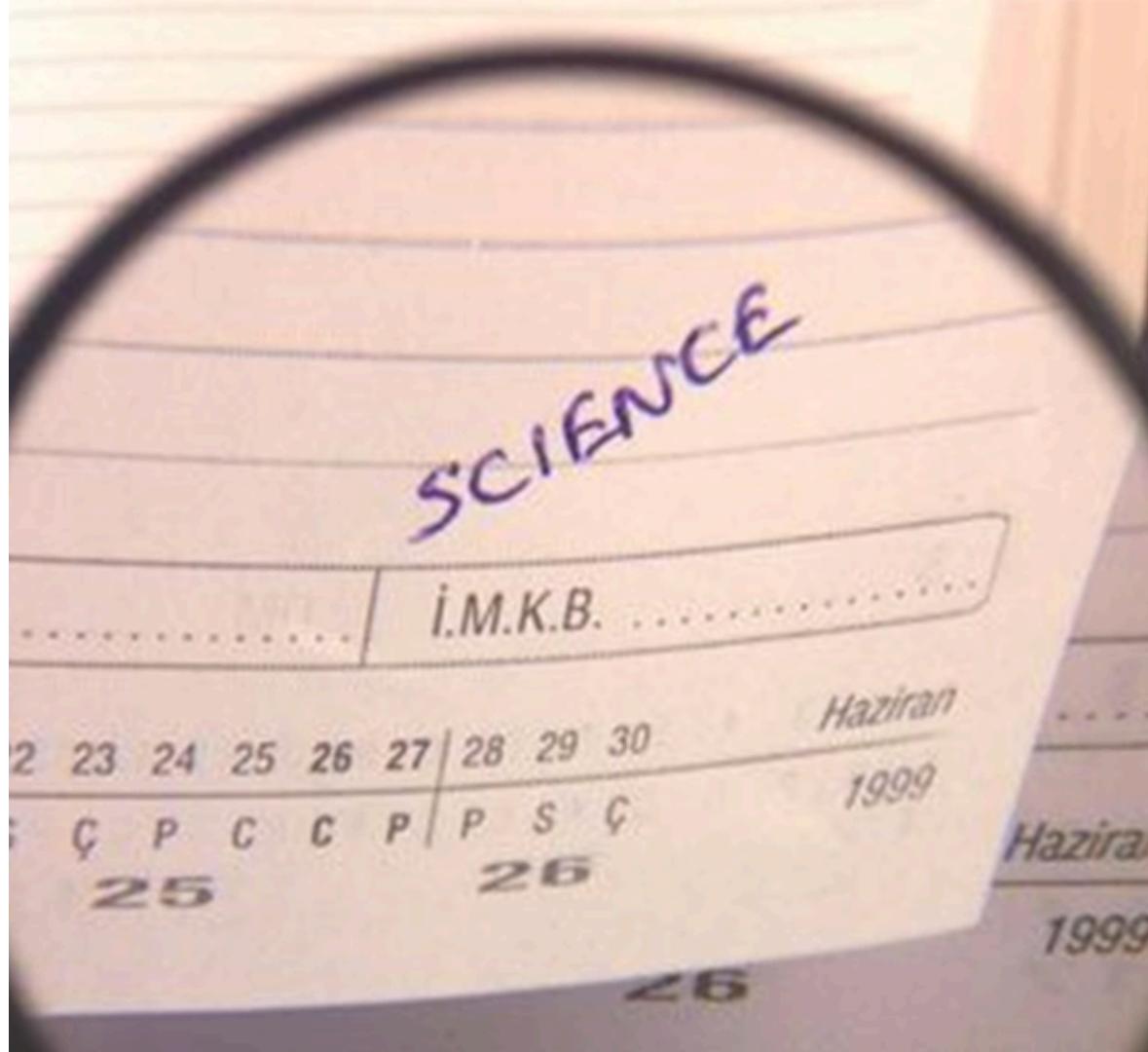
Coherence	Genres	Emotion keywords	Intended audience	Plot keywords	$\emptyset$
Entropy	0.050	0.016	0.048	0.000	NA
KLD	0.098	0.055	0.067	0.068	NA
Mean	0.114	0.113	0.097	0.106	0.104
Weighted Mean	0.010	0.068	0.072	-0.028	0.104
Std. dev.	-0.331	-0.438	-0.383	-0.279	-0.432
Weighted Std. dev.	-0.398	<b>-0.455</b>	-0.432	-0.394	-0.432
Size	0.077	0.074	0.066	0.088	0.072
Random				-0.015	
Number of ratings				-0.072	
Average rating				-0.104	

## Experiments

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## Use rating coherence for recommendation

Divide users into **coherent** and **incoherent** – with **higher** an lower **magic barrier**

Movielens 1M

Train each group separately

Evaluate each group separately



# Recommendation and Evaluation

Algorithm: K-NN, Pearson

Training sets

- “Easy” users split
- “Difficult” users split
- All users split

Evaluation sets

- “Easy” users split
- “Difficult” users split
- All users split



# Evaluation

## Comparisons

All - All

All – Easy

All – Difficult

Easy – Easy

Difficult – Difficult



RMSE: 1.090

User coverage: 100%

# Evaluation

## Comparisons

All - All

**All – Easy**

All – Difficult

Easy – Easy

Difficult – Difficult



RMSE: 0.974

User coverage: 50%

# Evaluation

## Comparisons

All - All

All – Easy

**All – Difficult**

Easy – Easy

Difficult – Difficult



RMSE: 1.195

User coverage: 50%

# Evaluation

## Comparisons

All - All

All – Easy

All – Difficult

**Easy – Easy**

Difficult – Difficult



RMSE: 0.933

User coverage: 50%

# Evaluation

## Comparisons

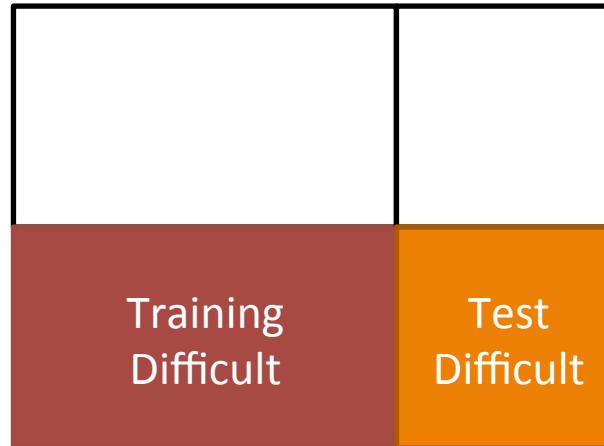
All - All

All – Easy

All – Difficult

Easy – Easy

**Difficult – Difficult**



RMSE: 1.226

User coverage: 50%

# Results

Subset	RMSE	User Coverage
All	1.090	100%
All-Easy	0.974	50%
All-Diff	1.195	50%
Easy-Easy	0.933	50%
Diff-Diff	1.226	50%

# Results

Subset	RMSE	User Coverage
All	1.090	100%
All-Easy	0.974	50% (easy)
All-Diff	1.195	50% (diff)
Easy-Easy	0.933	50% (easy)
Diff-Diff	1.226	50% (diff)

RMSE  
average:  
**1.084**

# Results

Subset	RMSE	User Coverage
All	1.090	100%
All-Easy	0.974	50% (easy)
All-Diff	1.195	50% (diff)
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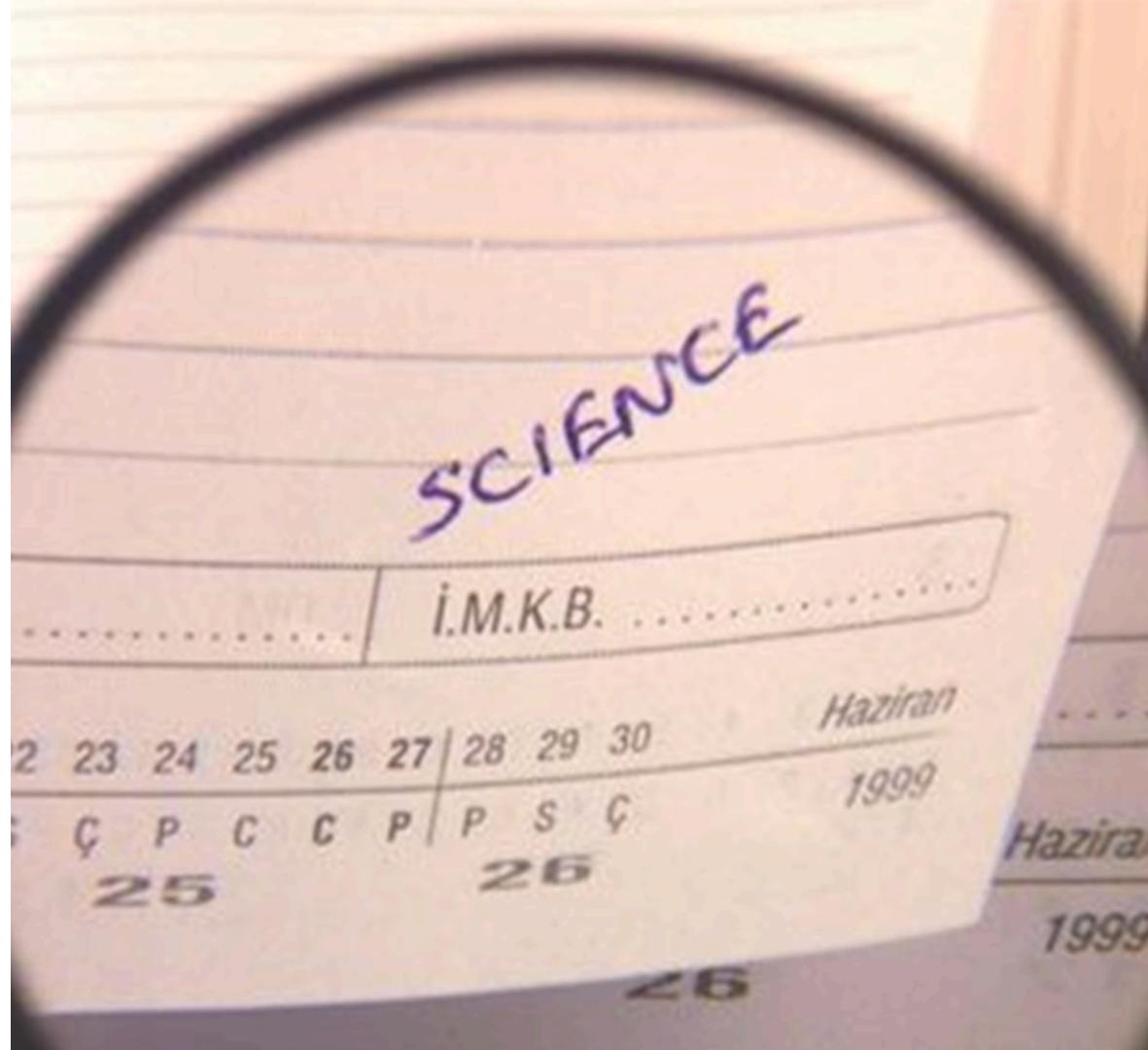
RMSE  
average:  
**1.064**

## Experiments

**EX1:** Is rating coherence a good predictor for the Magic Barrier?



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Especially when we do not have re-ratings/magic barrier?



## Conclusions

Rating coherence within an item's feature space *is* related to the magic barrier

Rating coherence can be used to predict users' rating inconsistencies

A user's rating inconsistencies tell us how well our system performs for that user – i.e. whether we need to optimize further



**Thanks!**

**Questions?**

More recommender systems:  
[www.recsyswiki.com](http://www.recsyswiki.com)

# Image credits

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