Walk the Talk

Analyzing the relation between implicit and explicit feedback for preference elicitation

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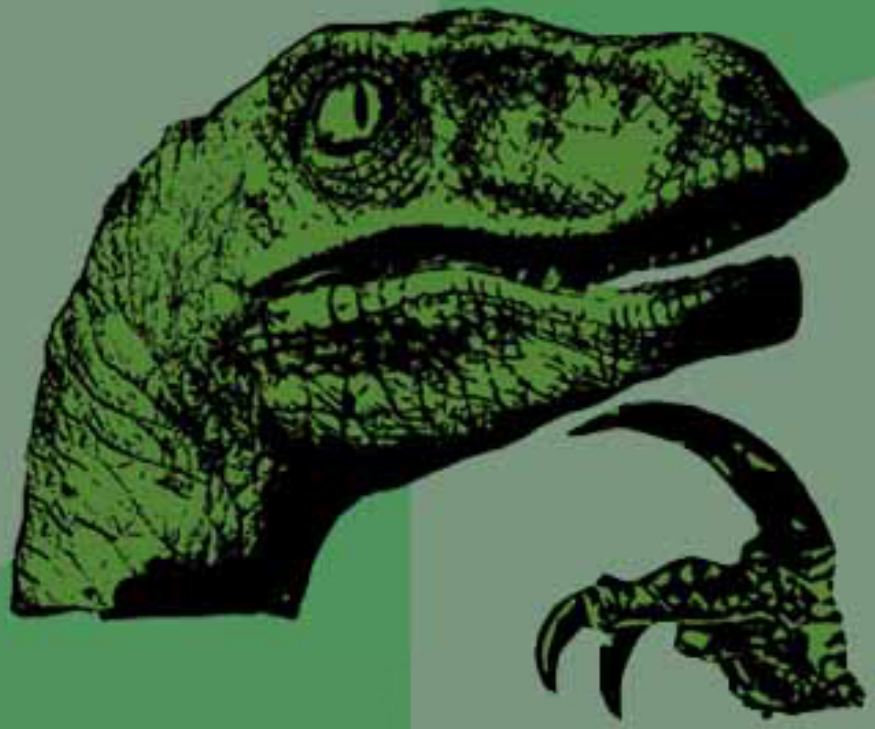
Which is the plan of this presentation?

Ah?

Outline

- Introduction (motivation)
- The survey on last.fm users
  - What did we crawl, what did we ask, sampling strategy, results
- General analysis of the results
- Regression Analysis
- Discussion, ongoing work and (some) conclusions

Which motivation did you have



To do this research?

Introduction (1/2)

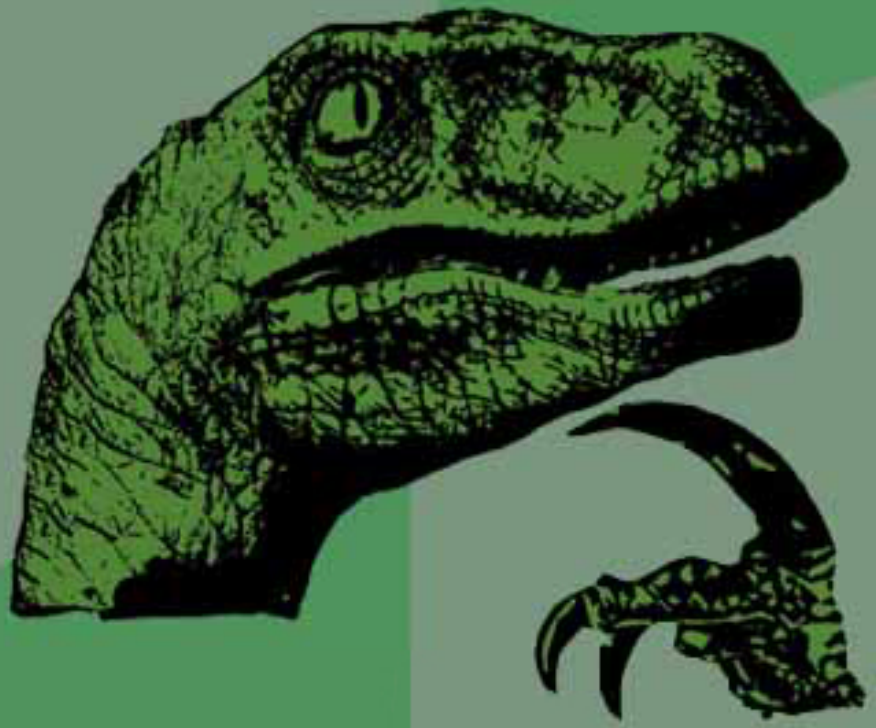
- Most of recommender system approaches rely on explicit information of the users, but…
- Explicit feedback: scarce (people are not especially eager to rate or to provide personal info)
- Implicit feedback: Is less scarce, but (Hu et al., 2008)

There's no negative feedback	… and if you watch a TV program just once or twice?
Noisy	… but explicit feedback is also noisy (Amatriain et al., 2009)
Preference & Confidence	**… we aim to map the I.F. to preference (our main goal)**
Lack of evaluation metrics	**… if we can map I.F. and E.F., we can have a comparable evaluation**

Introduction (2/2)

- Is it possible to map implicit behavior to explicit preference (ratings)?
- Which variables better account for the amount of times a user listens to online albums? [Baltrunas & Amatriain CARS '09 workshop – RecSys 2009.]
- OUR APPROACH: Study with Last.fm users
  - Part I: demographics and online music consumption
  - Part II: Rating 100 albums collected from their last.fm user profile

Which user data did you obtain from last.fm users?



2.1 Demographic/Consumption Data

- **Gender**
- **Age**
- **Country**
- Hours per week spent on internet [int_hrs_per_week]
- Hours per week listening to music online [msc_hrs_per_week]
- Number of concerts per year [conc_per_year]
- Do you read specialized music blogs or magazines? [blogs_mag]
- Do you have experience evaluating music online? [rate_music]
- How frequently do you buy physical music records? [buy_records]
- How frequently do you buy music online? [buy_online]
- Do you prefer listening to single tracks, whole albums or either way? [track_or_CD]

2.2 Albums listened to in last.fm

2.3 Survey Part II

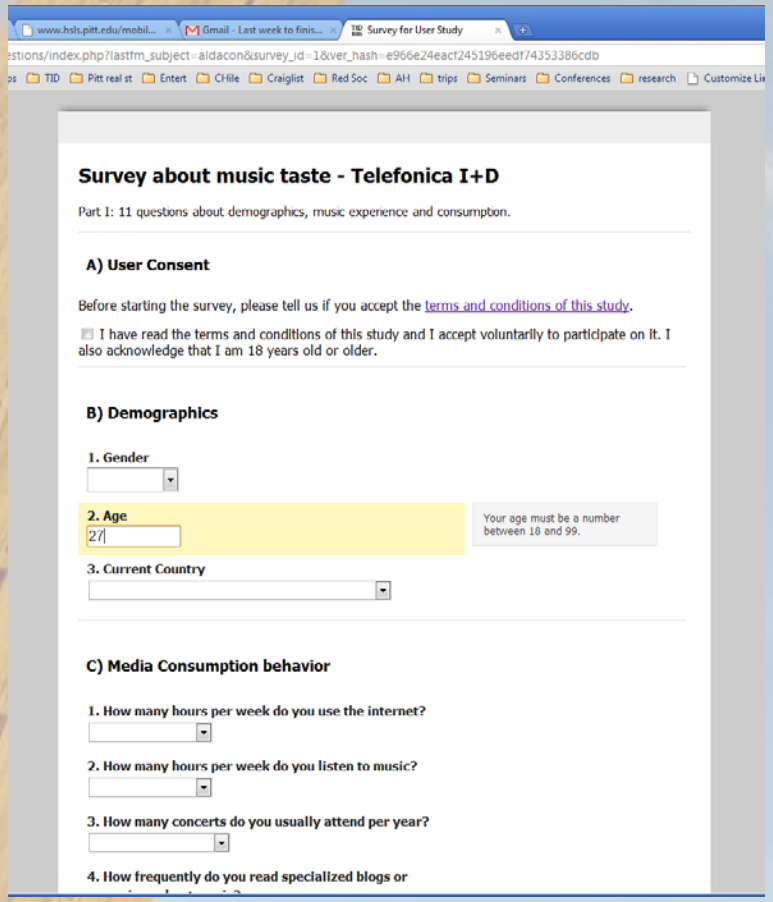
- For item (album) sampling, we accounted for
  - **Implicit Feedback** (IF): playcount for a user on a given album. Changed to scale [1-3], 3 means being more listened to.
  - **Global Popularity** (GP): global playcount for all users on a given album [1-3]. Changed to scale [1-3], 3 means being more listened to.
  - **Recentness** (R) : time elapsed since user played a given album. Changed to scale [1-3], 3 means being listened to more recently.

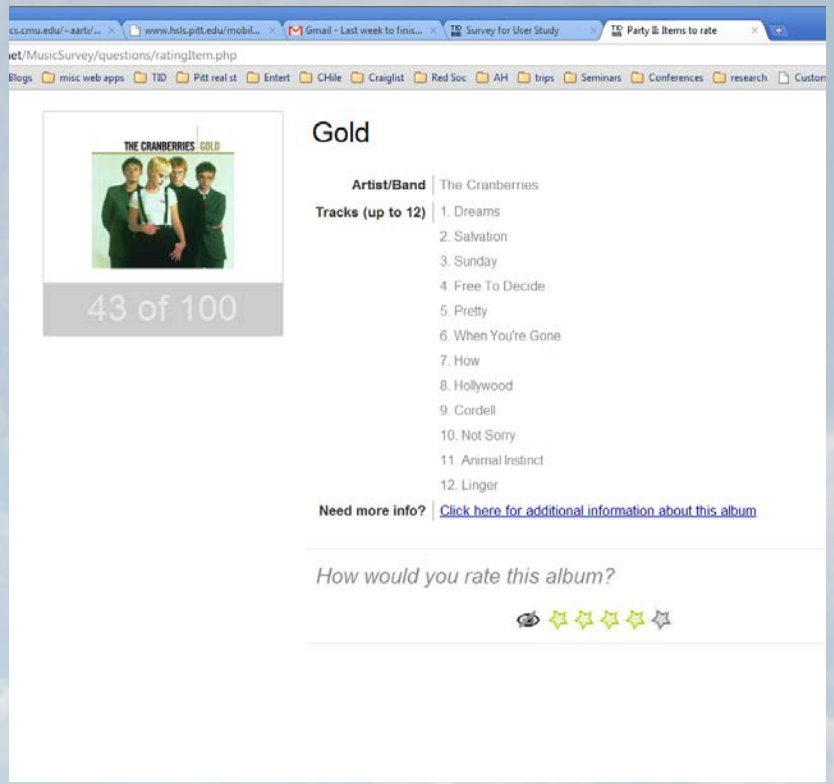
GP	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3
IF	1	1	1	2	2	2	3	3	3	1	1	1	2	2	2	3	3	3	1	1	1	2	2	2	3	3	3
R	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
%	8,4	6	6,8	5,5	4	5,5	3,7	2,5	4,6	6,4	3,5	4,2	3,8	2	3,3	2	1	2,2	5,8	3	4	3,3	1,6	2,6	1,6	1	2

Table 1. Distribution of items in different bins. GP: global popularity, IF: implicit feedback, R: recentness, #: number of items in the bin, % : percentage of items in the bin.

2.4 Survey Screenshots

- Requirements: 18 y.o., scrobblings > 5000





2.5 Survey Part I – Results (1/2)

151 users started	**127 users completed**	**114 after filtering outliers**

Users from 23 countries	**25 users from Spain, 15 from USA, 16 from UK**

80% spent 20 or more hours per week on the internet	**50% listened to over 20 hours per week of music**

9% did not attend music concerts	**30% went to 11 or more concerts per year**

2.5 Survey Part I – Results (2/2)

35% read sometimes music magazines or blogs	**20% read them every week**
50% never or seldom rated music online	
45% bought between 1 and 10 records per year	**18% did not buy any**
35% never bought music online	**8% bought music online at least once per month**
14% preferred listening to single tracks	**45% preferred listening to albums, ~40% either way**

Ok, ok, now…

What did you get after analyzing the results?

3.6 General Analysis - Assumptions

- We “expect” strong positive correlation between ratings and implicit feedback
- We “expect” some level of positive correlation between ratings and recentness
- We (don’t?) expect a significant relation between ratings and global popularity
- **On demographic data**: Just listening to track or album shows a significant effect (using ANOVA) $F(2, 62) = 3.949$, $p = 0.024$

So far so good

Are you able to predict ratings with those variables?

4 Regression Analysis

M2: implicit feedback & recentness

M4: Interaction of implicit feedback & recentness

M1: implicit feedback

M3: implicit feedback, recentness, global popularity

- Model 1: $r_{iu} = \beta_0 + \beta_1 \cdot if_{iu}$
- Model 2: $r_{iu} = \beta_0 + \beta_1 \cdot if_{iu} + \beta_2 \cdot re_{iu}$
- Model 3: $r_{iu} = \beta_0 + \beta_1 \cdot if_{iu} + \beta_2 \cdot re_{iu} + \beta_3 \cdot gp_i$
- Model 4: $r_{iu} = \beta_0 + \beta_1 \cdot if_{iu} + \beta_2 \cdot re_{iu} + \beta_3 \cdot if_{iu} \cdot re_{iu}$

Model	R^2	*F-value*	*p-value*	β_0	β_1	β_2	β_3
1	0.125	$F(1, 10120) = 1146$	$< 2.2 \cdot 10{-}16$	2.726	0.499	-	-
2	0.1358	$F(2, 10019) = 794.8$	$< 2.2 \cdot 10^{-16}$	2.491	0.484	0.133	-
3	0.1362	$F(3, 10018) = 531.8$	$< 2.2 \cdot 10^{-16}$	2.435	0.486	0.134	0.0285
4	0.1368	$F(3, 10018) = 534.7$	$< 2.2 \cdot 10^{-16}$	2.677	0.379	0.038	0.053

Table 1. Regression Results. R^2, F-value, and p-value for the 5 models.

- Including Recentness increases R2 in more than 10% [1 -> 2]
- Including GP increases R2, not much compared to RE + IF [1 -> 3]
- Not Including GP, but including interaction between IF and RE improves the variance of the DV explained by the regression model. [2 -> 4]

4.1 Regression Analysis

Model	RMSE1	RMSE2
User average	1.5308	1.1051
M1: Implicit feedback	1.4206	1.0402
M2: Implicit feedback + recentness	1.4136	1.034
M3: Implicit feedback + recentness + global popularity	1.4130	1.0338
M4: Interaction of Implicit feedback * recentness	1.4127	1.0332

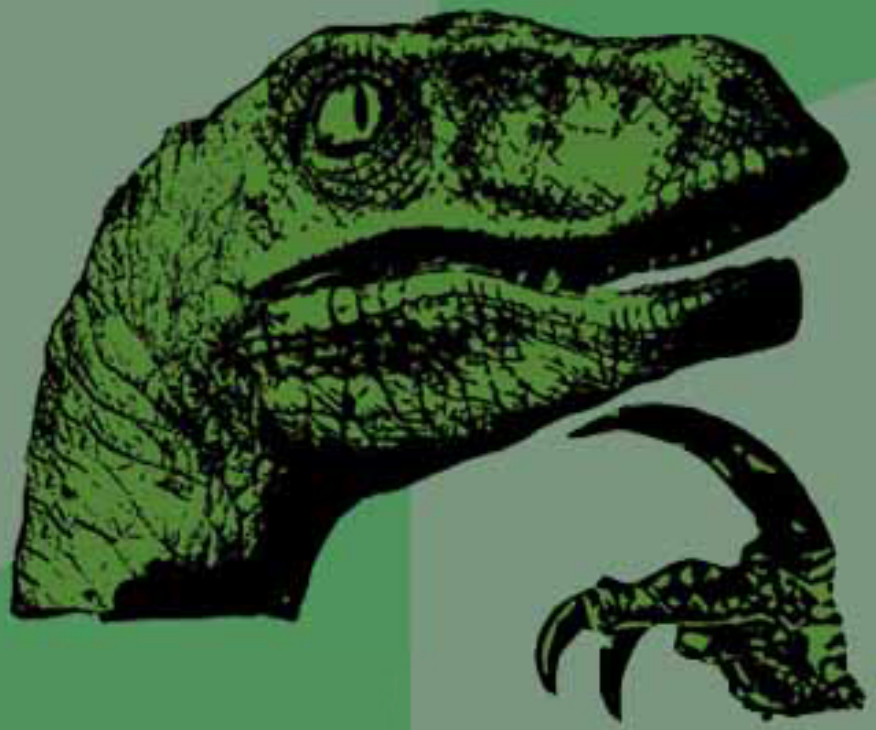
- We tested conclusions of regression analysis by predicting the score, checking RMSE in 10-fold cross validation.
- **Results of regression analysis are supported**.

4.2 Regression Analysis – Track or Album

Model	Tracks	Tracks/ Albums	Albums
User average	1.1833	1.1501	1.1306
M1: Implicit feedback	1.0417	1.0579	1.0257
M2: Implicit feedback + recentness	1.0383	1.0512	1.0169
M3: Implicit feedback + recentness + global popularity	1.0386	1.0507	1.0159
M4: Interaction of Implicit feedback * recentness	1.0384	1.049	1.0159

- Including this variable that seemed to have an effect in the general analysis, helped to improve accuracy of the model

Is this the end?



5. Ongoing Work

- Incorporate the nested nature of the ratings: they are not independent, so our regression will consider the user as a random factor to group ratings by user (mixed model)
- Ratings are not continuous by nature: we will use logistic regression (back up slide for further discussion)
- Using raw data (with some transformations) as the value of some predictors (implicit feedback and global popularity)

6. Conclusions

- Using a linear model, Implicit feedback and recentness can help to predict explicit feedback (in the form of ratings)
- Global popularity doesn't show a significant improvement in the prediction task
- Our model can help to relate implicit and explicit feedback, helping to evaluate and compare explicit and implicit recommender systems.

THANKS

- For spending your time listening to this talk ☺
- Questions?

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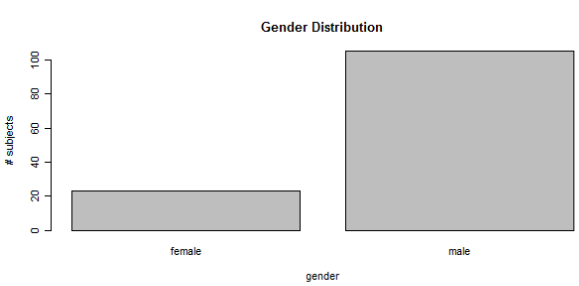
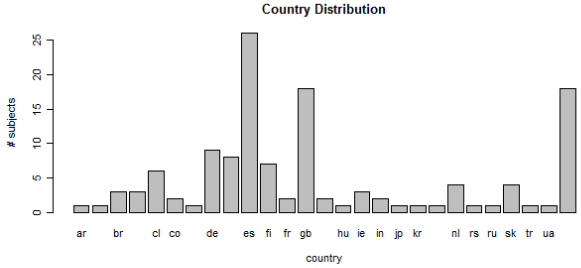
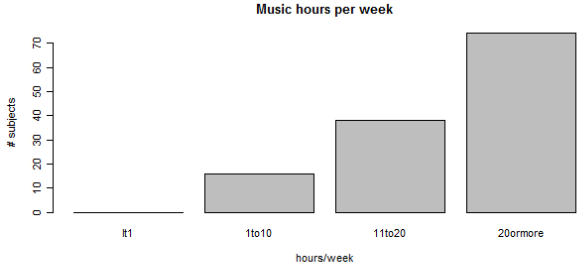
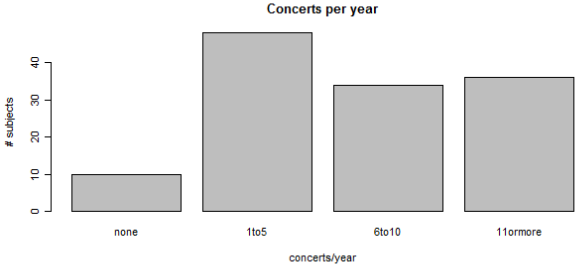
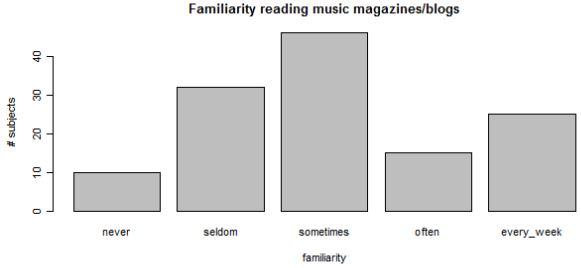
Survey part I results

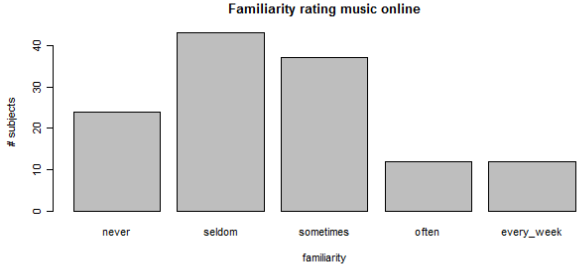


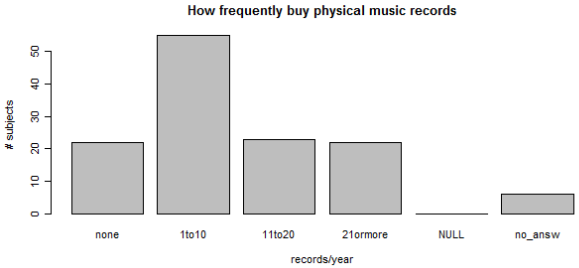


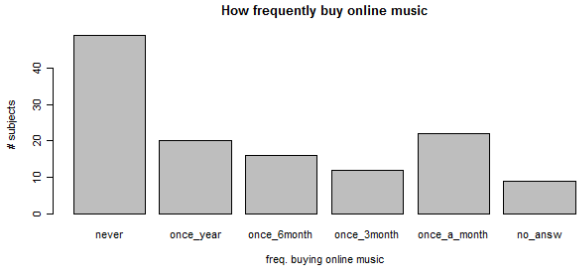


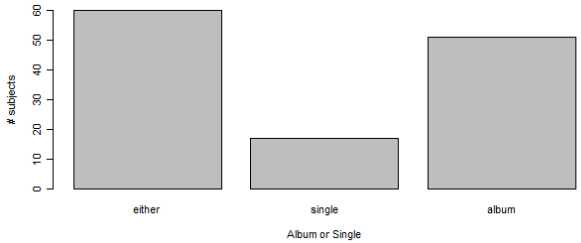




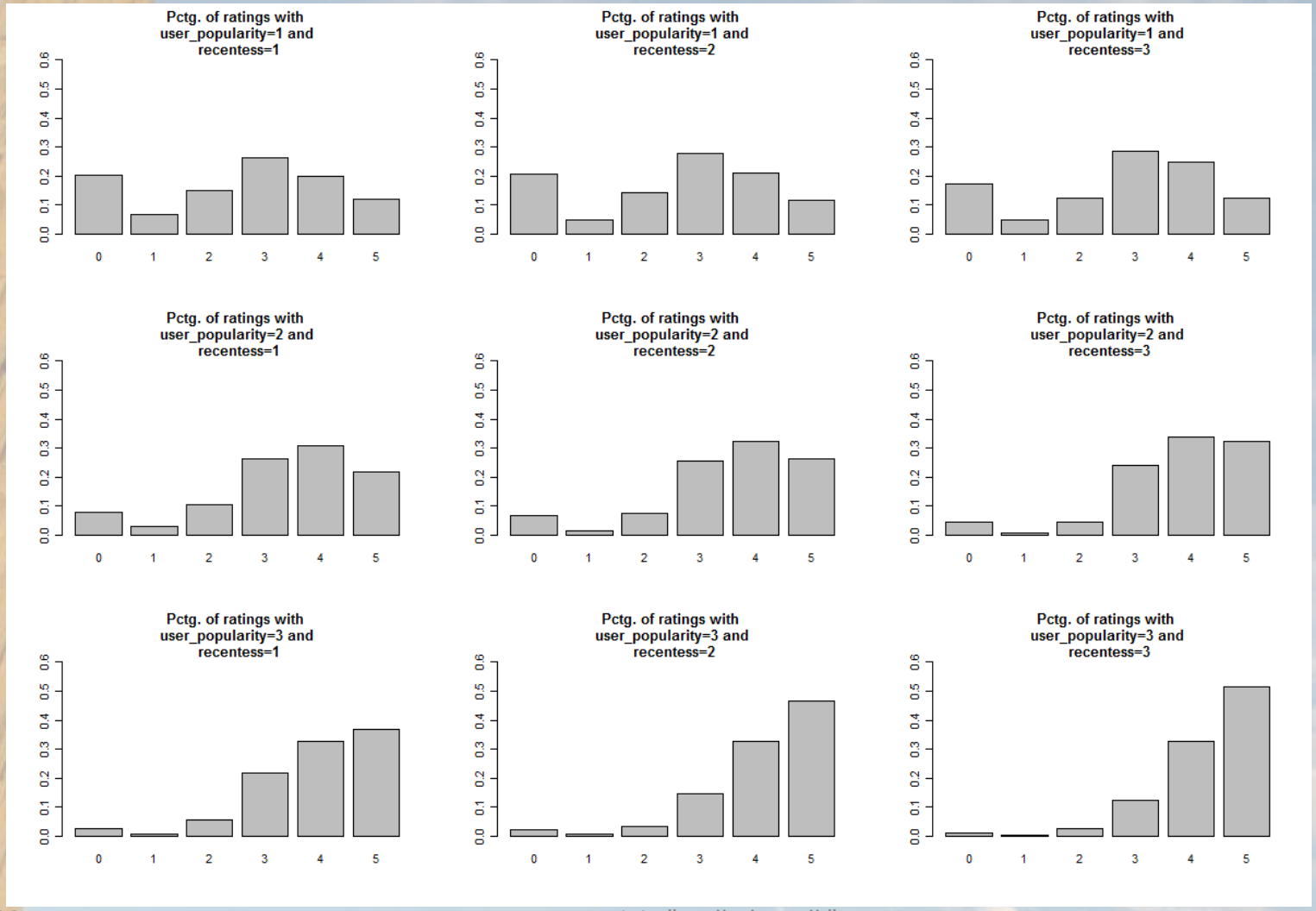






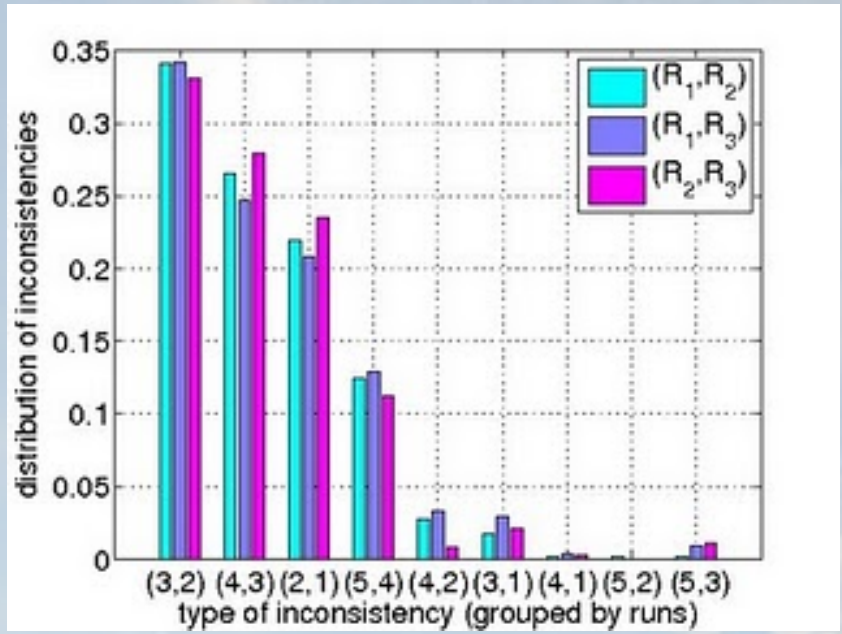


Graphics comparing % of ratings given 2 variables



Discussion: Evaluating with RMSE

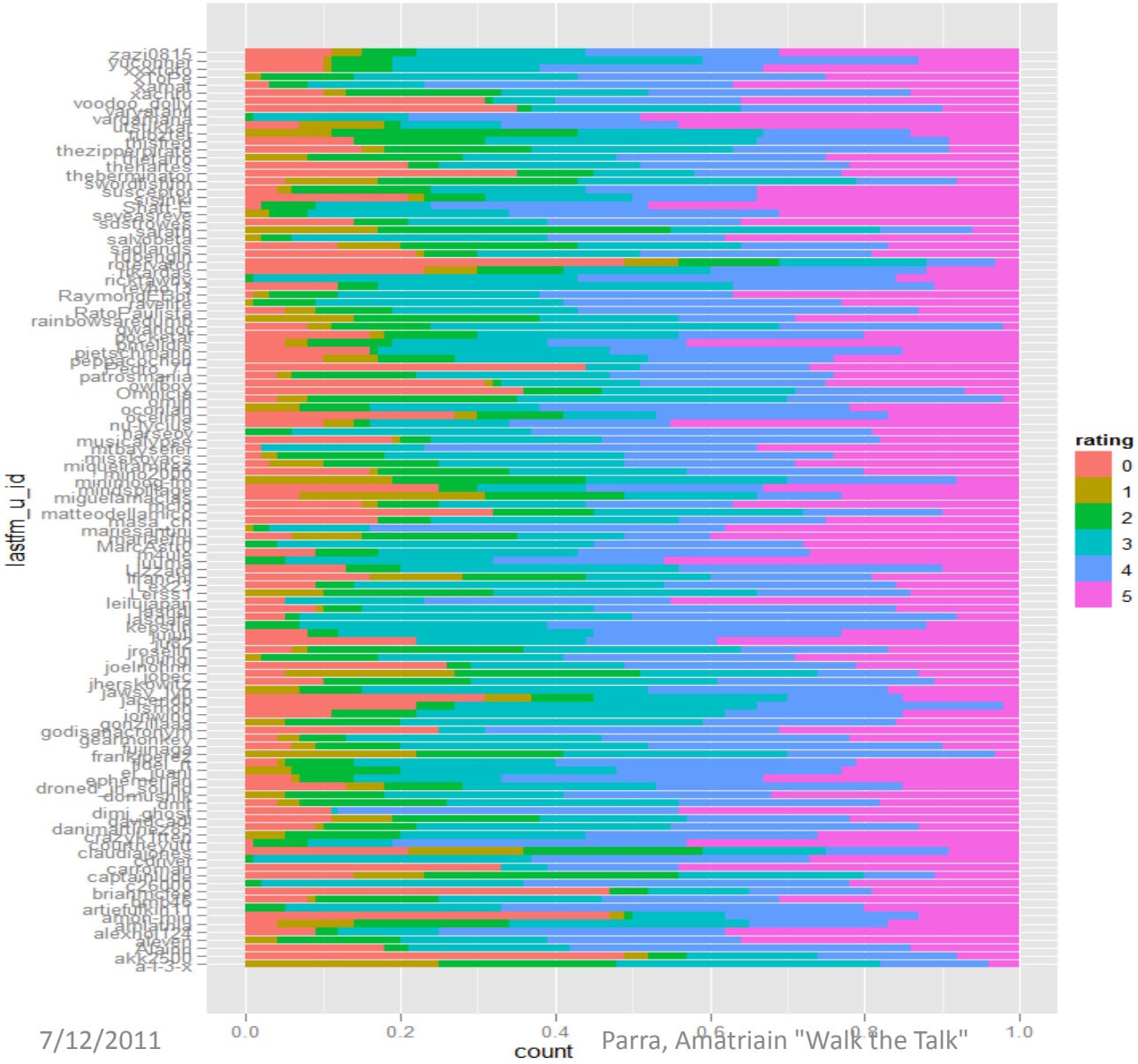
- Discussion after working on this paper: Should we continue using RMSE? IS NOT THE SAME MISPREDICTING a rating 2 by 3 than a rating 4 by 5



Comparison with Study of Duncan Watts

- … on evolution of artificial markets, where Watts concludes that people is actually influenced by popularity of items
- … but that are important differences with that study:
  - Watts study was trying to assess music quality, we asked users to avoid judging quality: just if they liked it or not.
  - In Watts study subjects were presented NEW songs that they HAD TO LISTEN TO in order to judge their quality.

3.1 Distribution of ratings



Average rating:

- Considering 0s:

3.206316

- Not considering 0s:

3.611144

3.2 Implicit Feedback

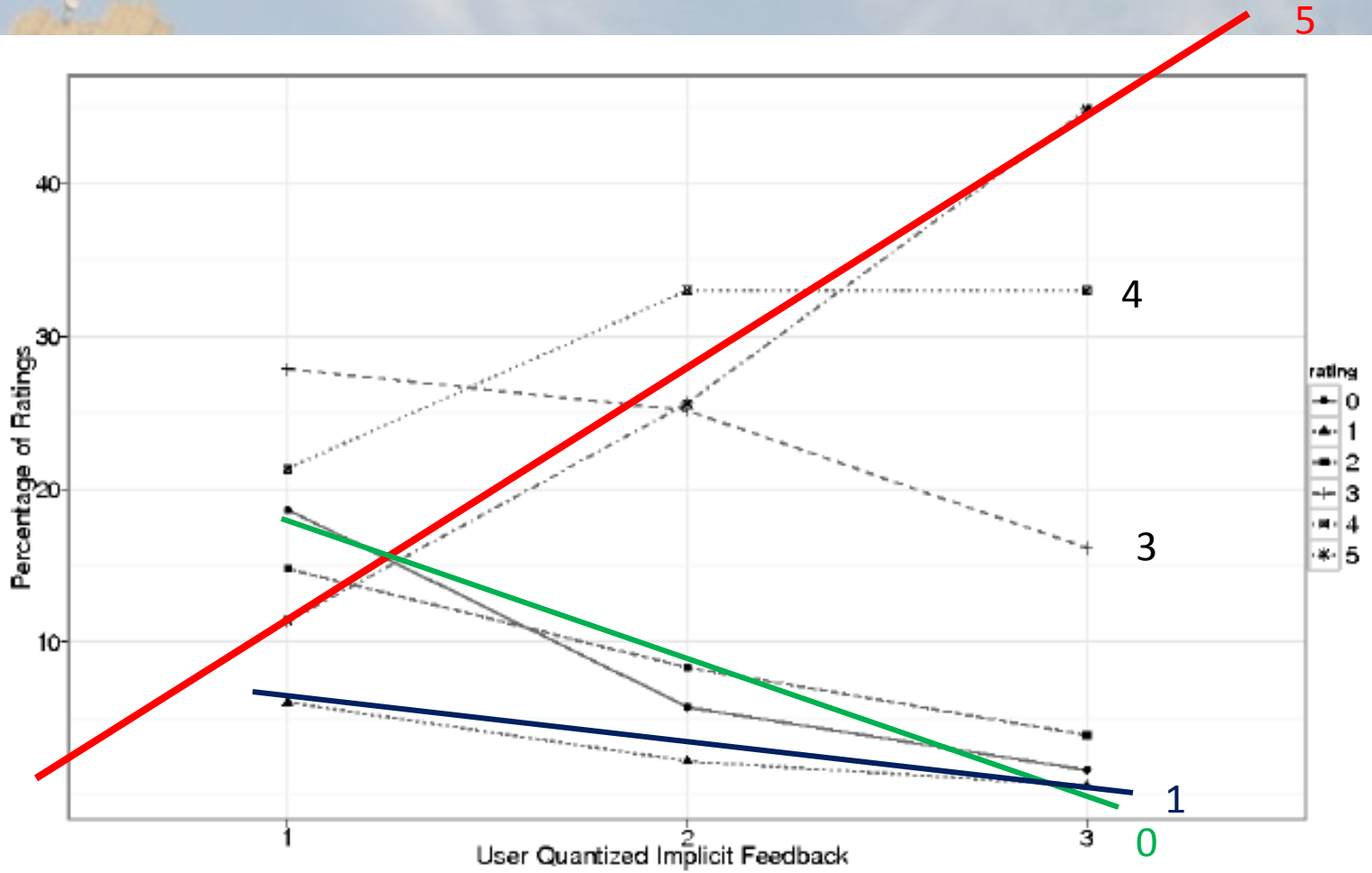


Fig. 3. Distribution of ratings given different values of implicit feedback

3.3 Recentness

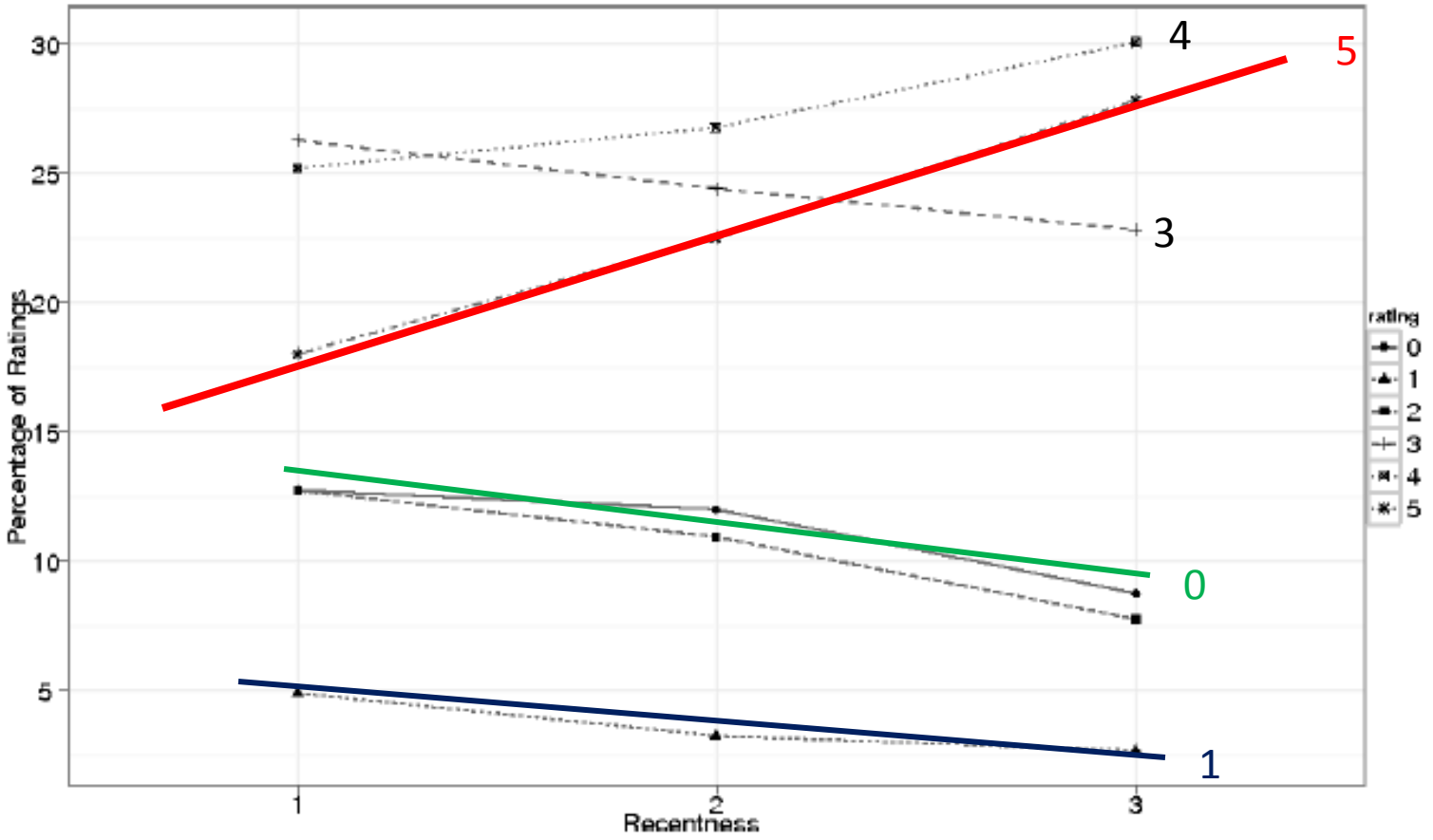


Fig. 4. Distribution of ratings given different values of recentness

3.4 Global Popularity

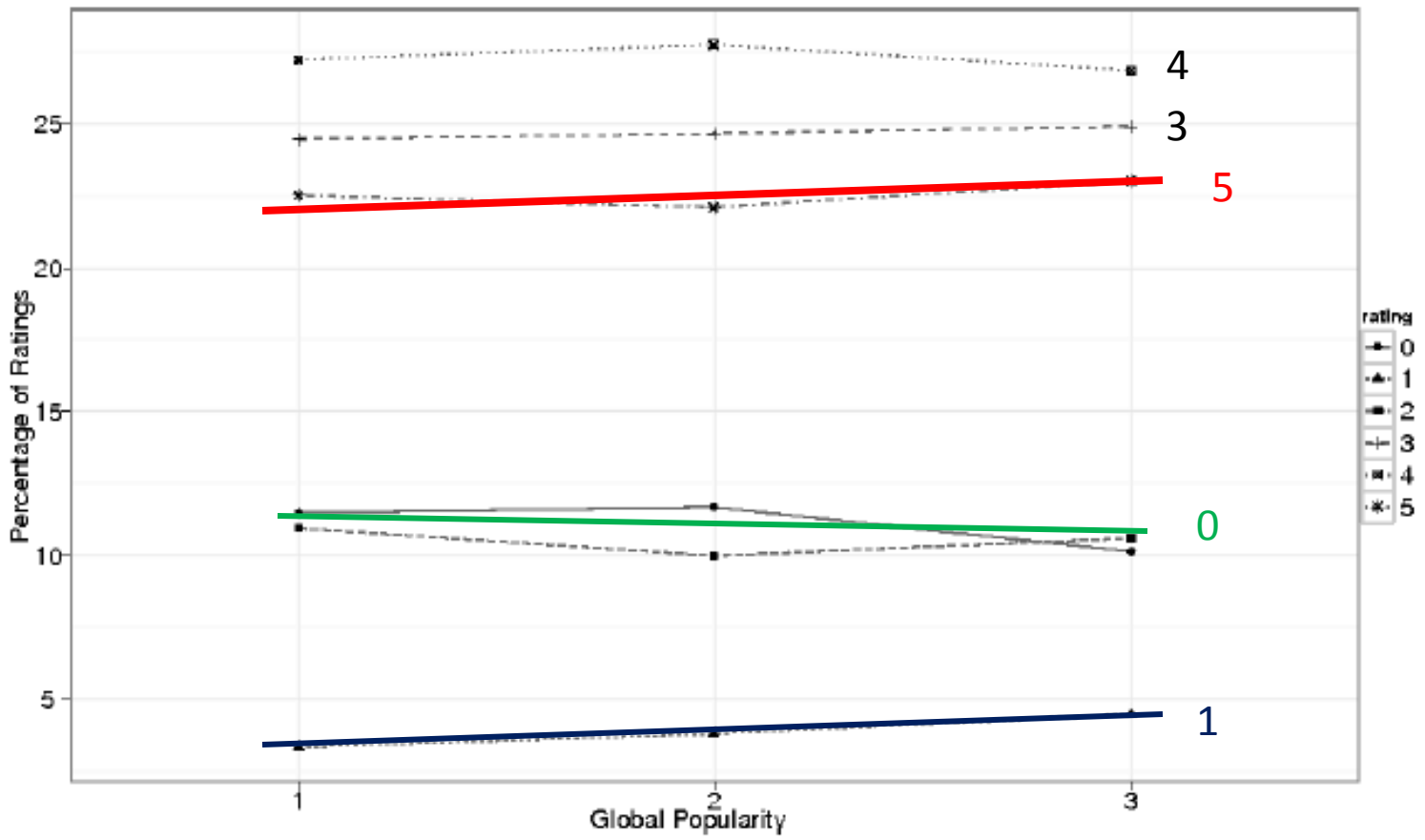


Fig. 5. Distribution of ratings given different values of overall popularity

3.5 Effect of Track or CD

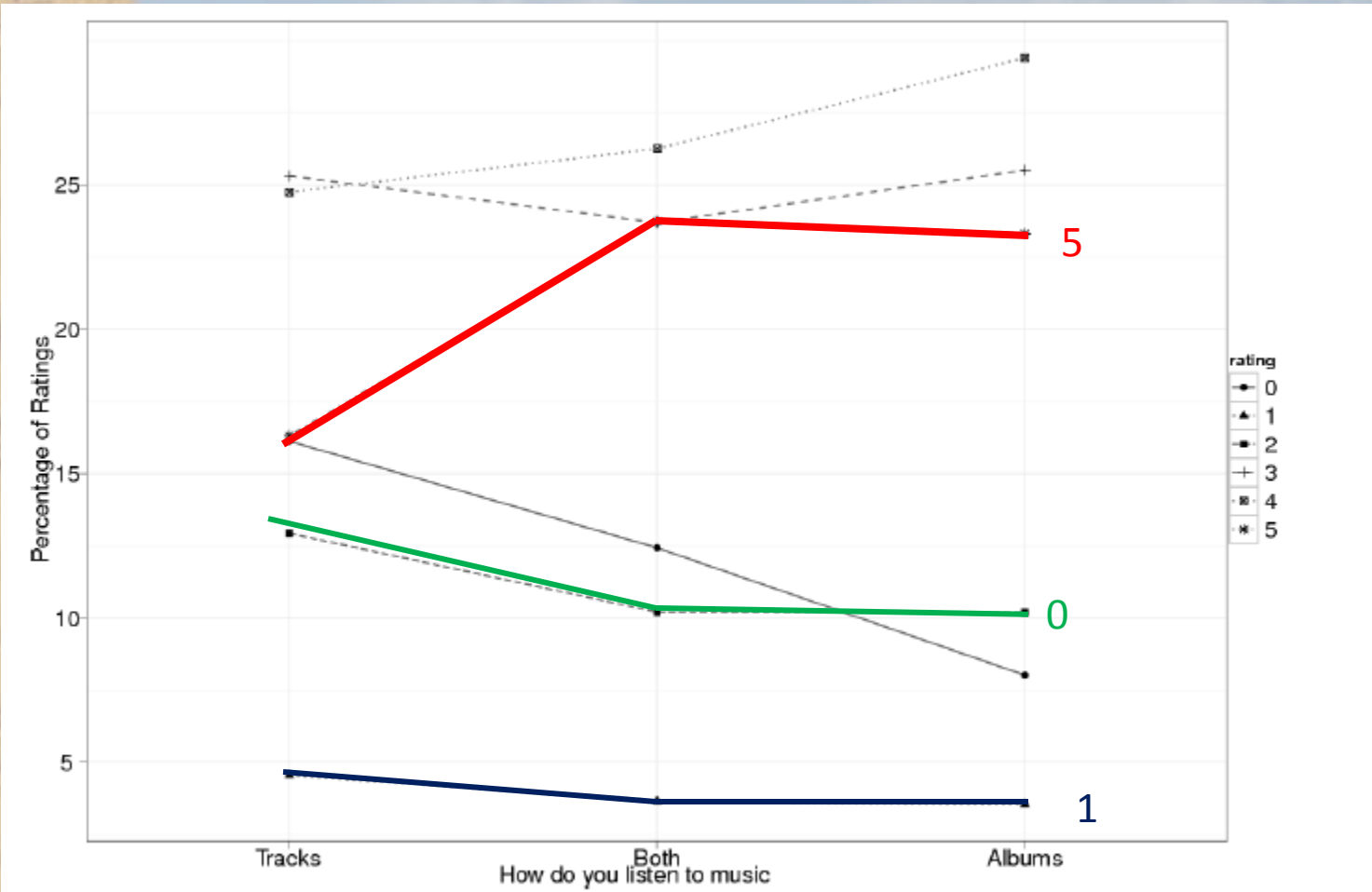


Fig. 6. Effect of listening style on percentage of ratings.

3 General Analysis

- Initial assumption: Rating and IF (# playcount) must be strongly correlated.

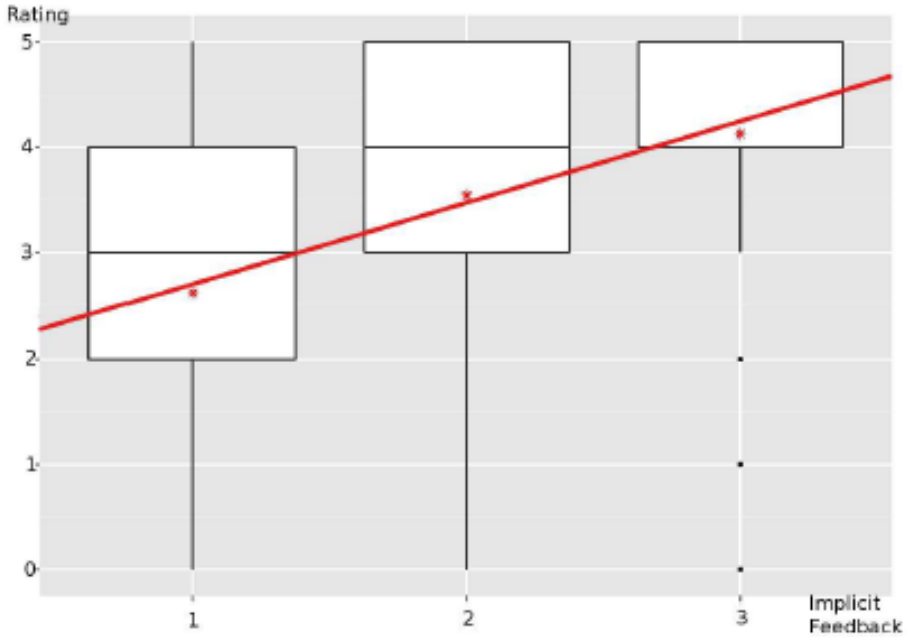


Fig. 2. Relation between implicit feedback and explicit ratings