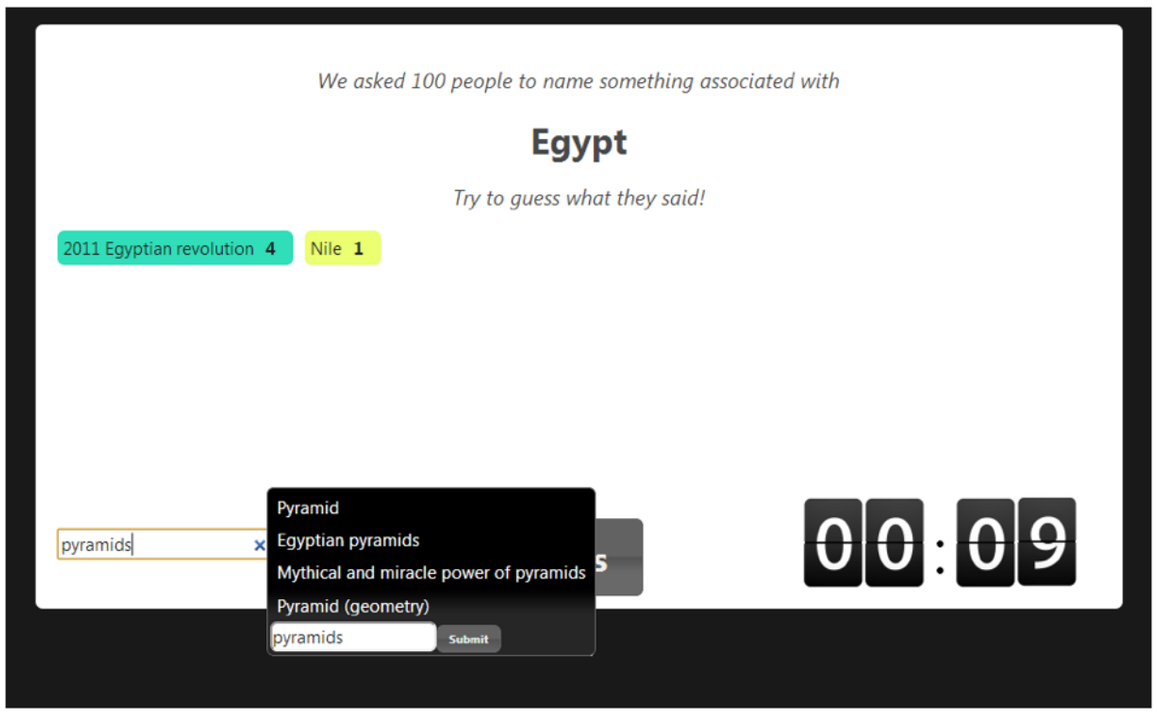
Collecting Links between Entities Ranked by Human Association Strengths



Jörn Hees, **Mohamed Khamis**, R. Biedert, S. Abdennadher & A. Dengel

2013-05-29
ESWC 2013 - Montpellier

Deutsches Forschungszentrum für Künstliche Intelligenz GmbH

Technische Universität Kaiserslautern

GUC German University in Cairo
الجامعة الألمانية بالقاهرة

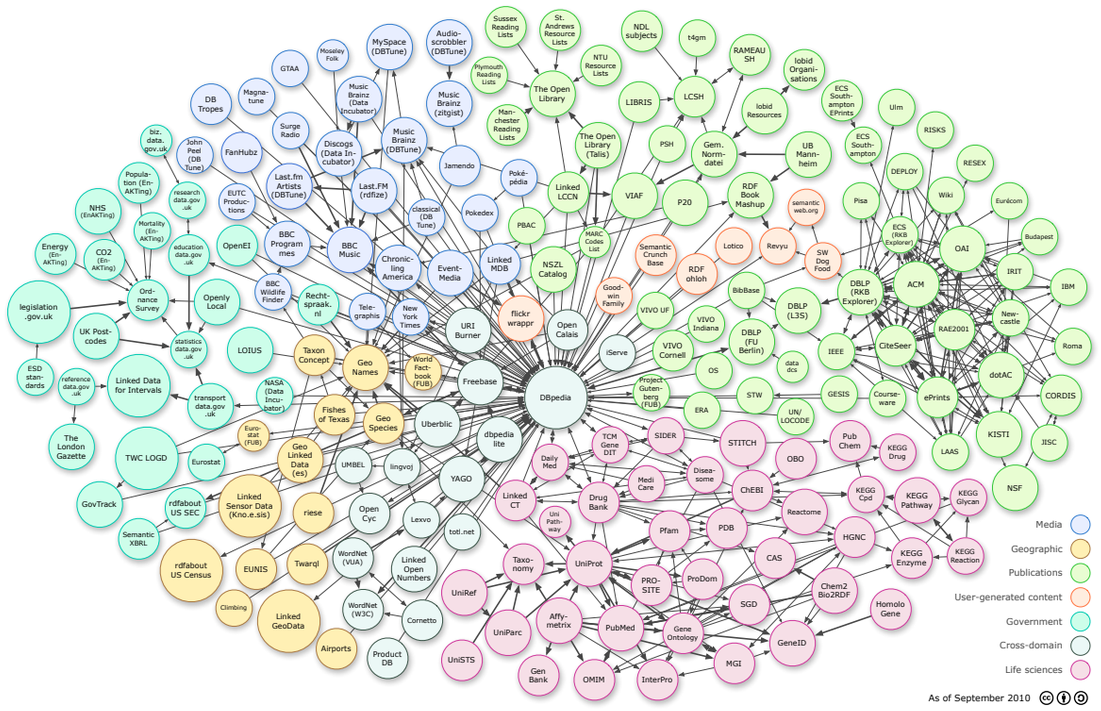
Outline

- Motivation
- Approach
  - Walkthrough
  - Matching Text to Semantic Entities
- Evaluation
- Summary & Discussion

Introduction

Introduction

- Linked Data / Semantic Web
  - World's largest decentralized Knowledge Base
  - Billions of facts



Introduction

- Linked Data / Semantic Web
  - World's largest decentralized Knowledge Base
  - Billions of facts

- Example: http://dbpedia.org/resource/Mark_Zuckerberg

  @dbpedia: http://dbpedia.org/resource/, @dbpedia-owl: http://dbpedia.org/ontology/

  - (dbpedia:Mark_Zuckerberg, dbpedia-owl:birthPlace, dbpedia:White_Plains,_New_York)
  - "Mark Zuckerberg was born in White Plains, NY"

Introduction

- Problem:
  - "Mark Zuckerberg" is strongly associated with "Facebook"

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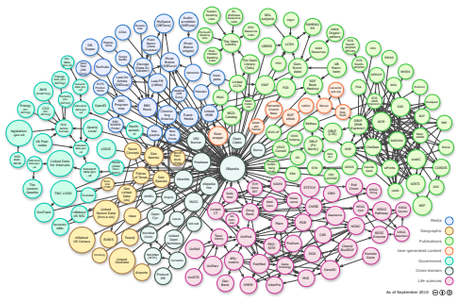
  - "Mark Zuckerberg" is strongly associated with "Facebook"

?p	?o
dcterms:subject	category:Directors_of_Facebook
dcterms:subject	category:Facebook_employees
dbpedia-owl:abstract	"... Facebook ..."@en
rdfs:comment	"... Facebook ..."@en
dbprop:knownFor	"Co-founding Facebook in 2004;"@en
dbprop:occupation	"Chairman and CEO of Facebook"@en
dbpedia-owl:wikiPageWikiLink	dbpedia:Facebook

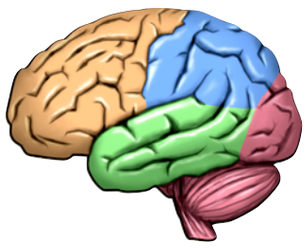
Motivation

Linked Data



- many facts
- much noise
- equally important
- reasoning?

Human Memory



- many facts
- much noise
- focus on important
- associative thinking

Associations

- Connect thoughts in our minds

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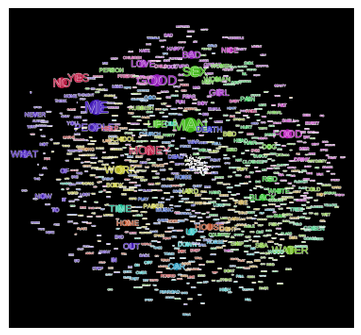
- Difference (non exclusive):
  - Semantic Similarity: table & bed
  - Association: waist & belt

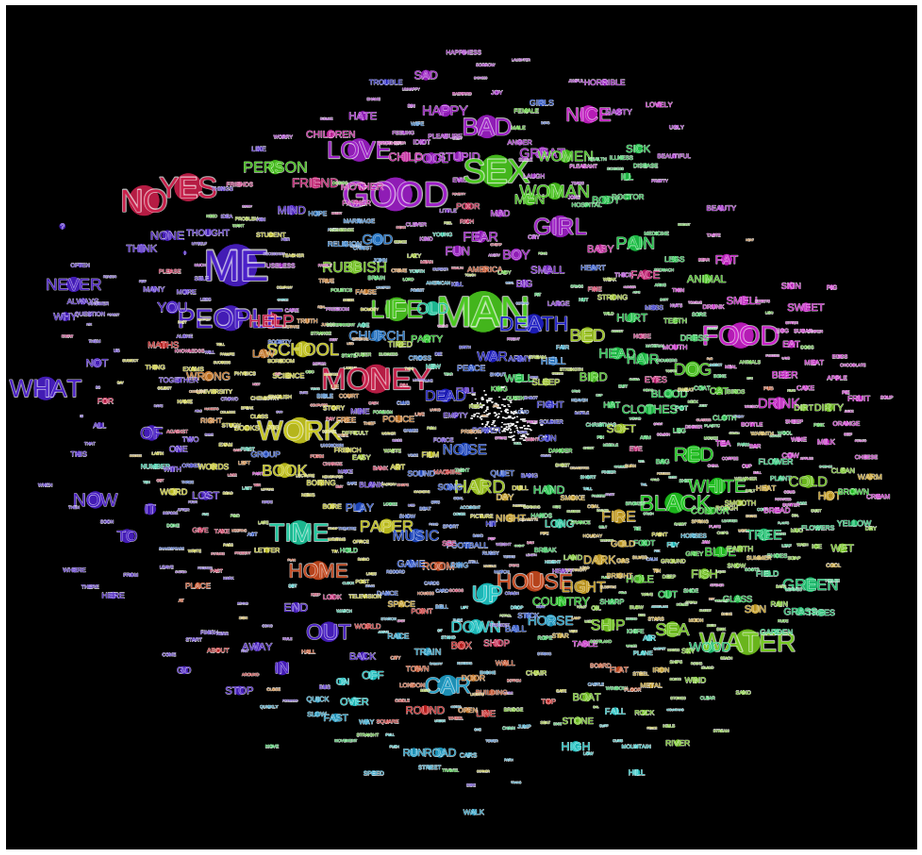
Associations

- Connect thoughts in our minds
- Difference (non exclusive):
  - Semantic Similarity: table & bed
  - Association: waist & belt
- Edinburgh Associative Thesaurus (Kiss, Armstrong, Milroy, Piper 1973)
  - plain text associations



Associations

- Collection Problems:
  - Ambiguity
  - Subjectivity
  - Tedious
  - Costly
  - Changes over time



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- Human Computation:
  - Outsource AI hard problems to humans
  - Collect the data

Approach

- Collect Associations between Semantic Entities
- Human Computation:
  - Outsource AI hard problems to humans
    - Collect the data
- Games With A Purpose
  - Solitaire (2003): 9 billion hours (von Ahn 2006)
  - Panama Canal: built in 20 million hours (less than a day of Solitaire)

Related GWAPs

- ESP Game (von Ahn, Dabbish 2004)

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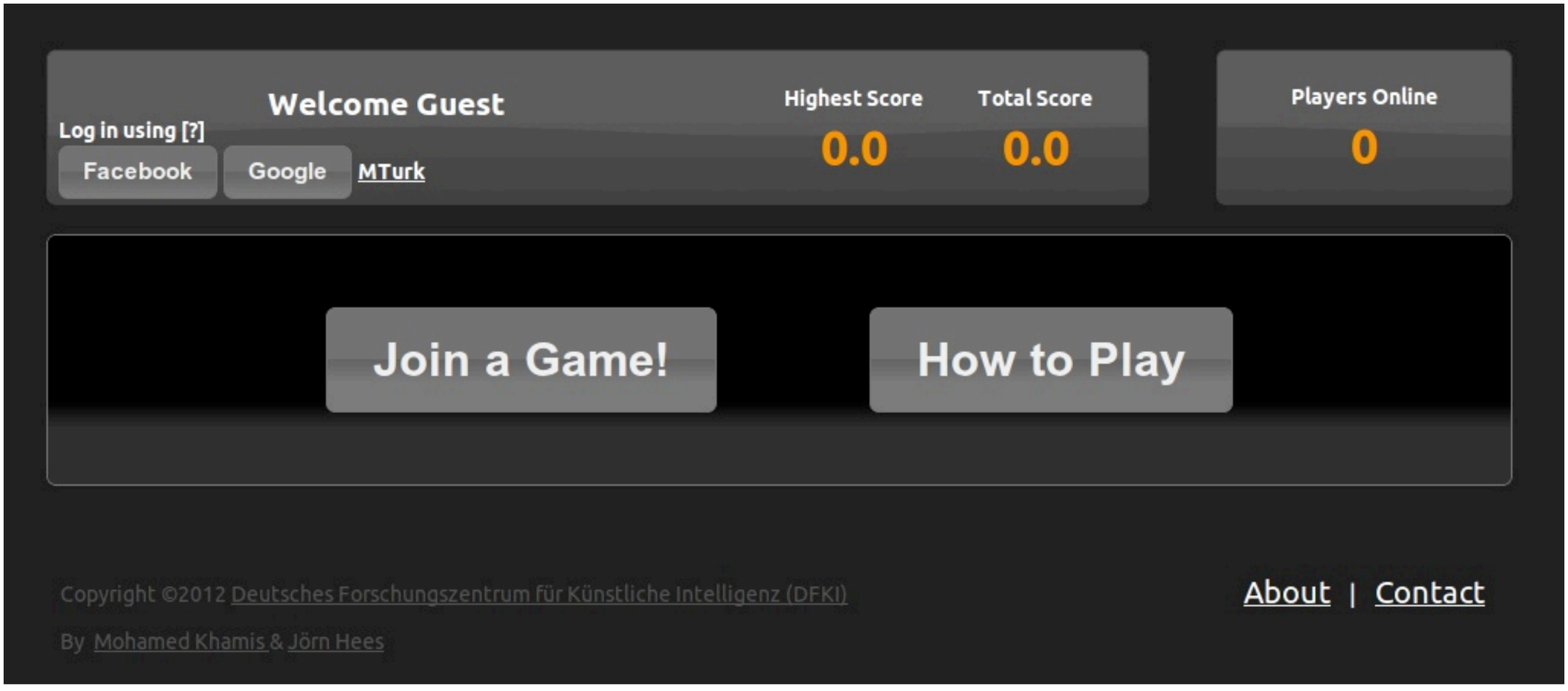
- Own
  - Associator (Hees, Roth-Berghofer, Dengel 2010)
  - BetterRelations (Hees et al. 2011)

Knowledge Test Game: Walkthrough

http://knowledgetestgame.org



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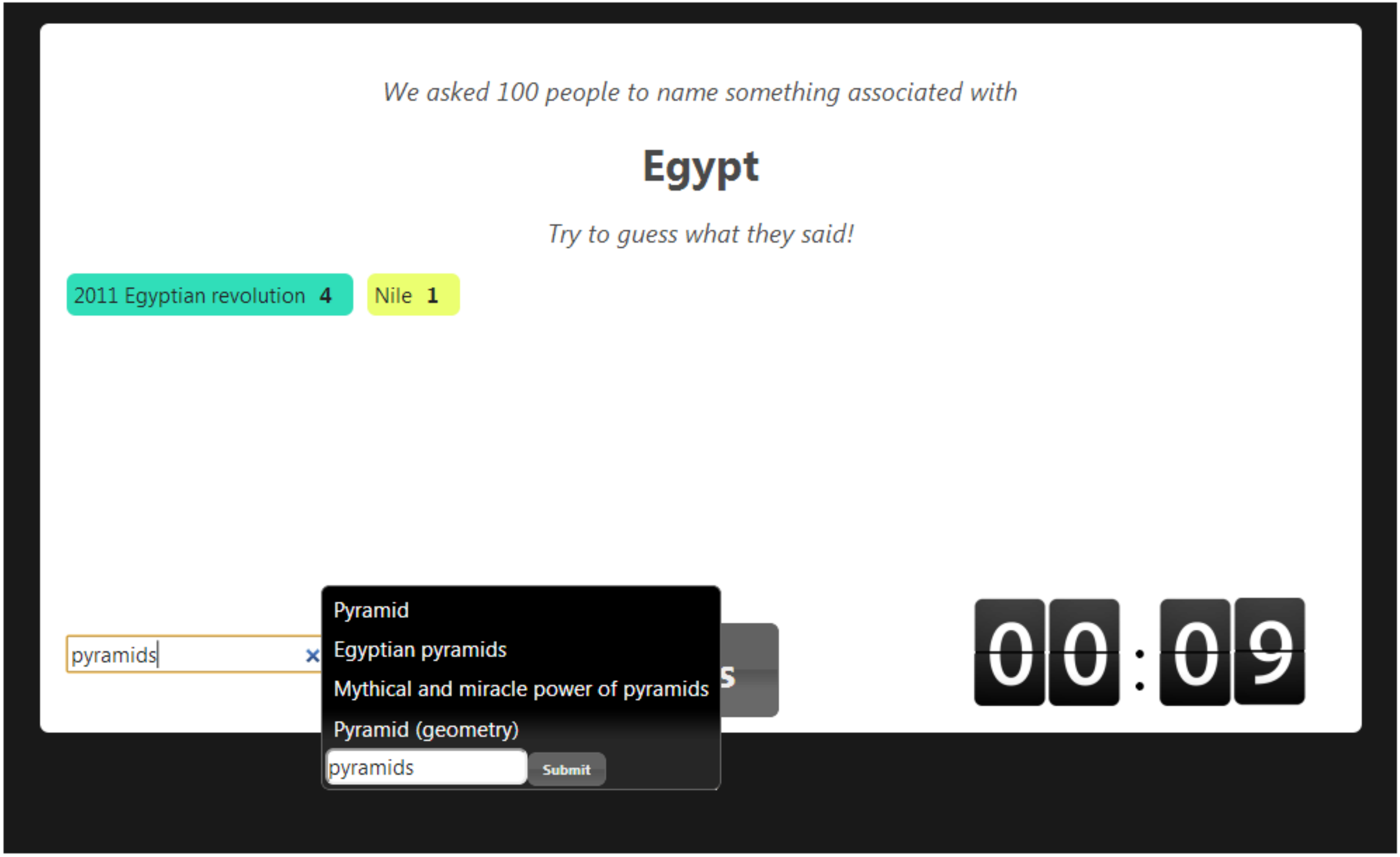

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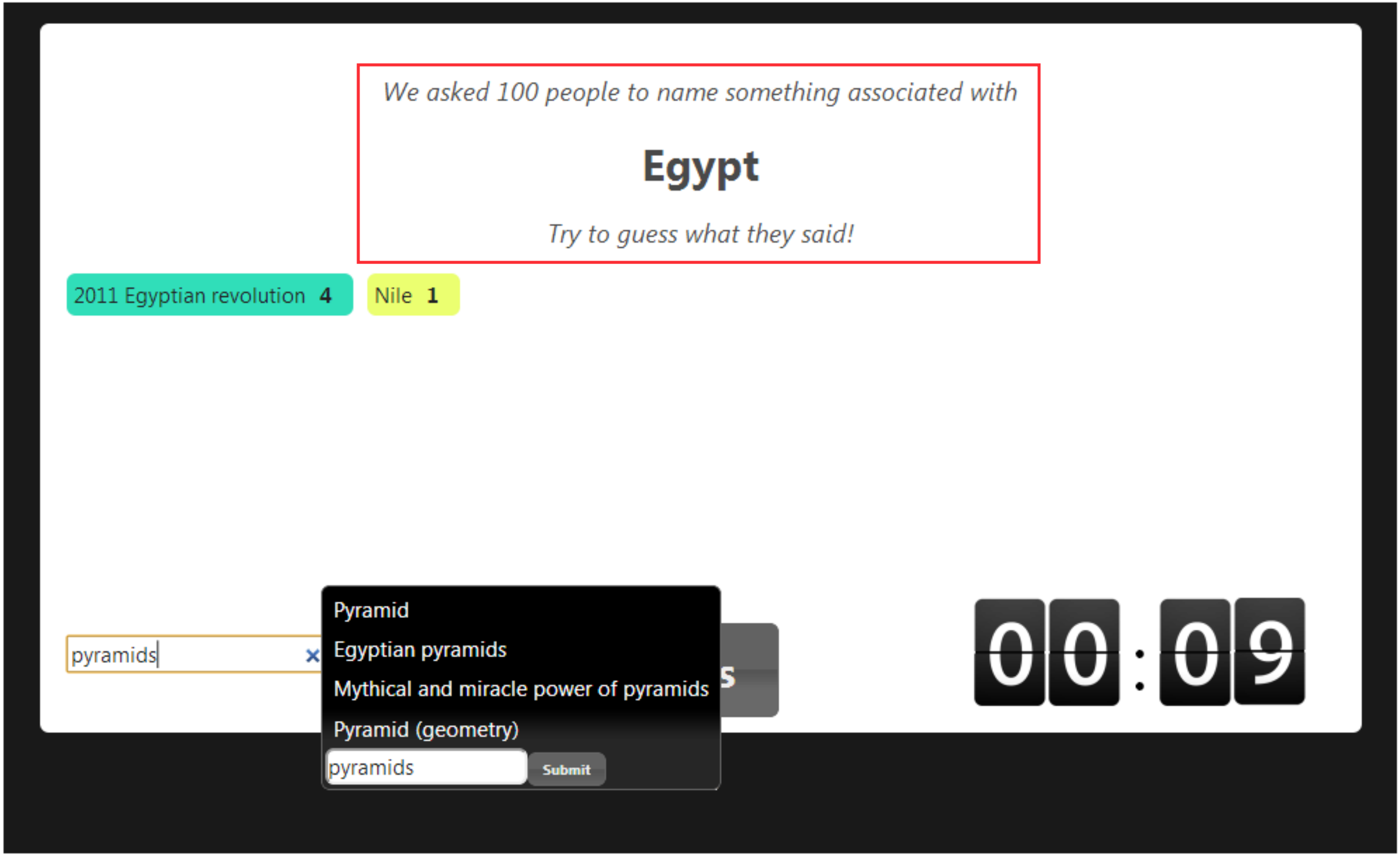

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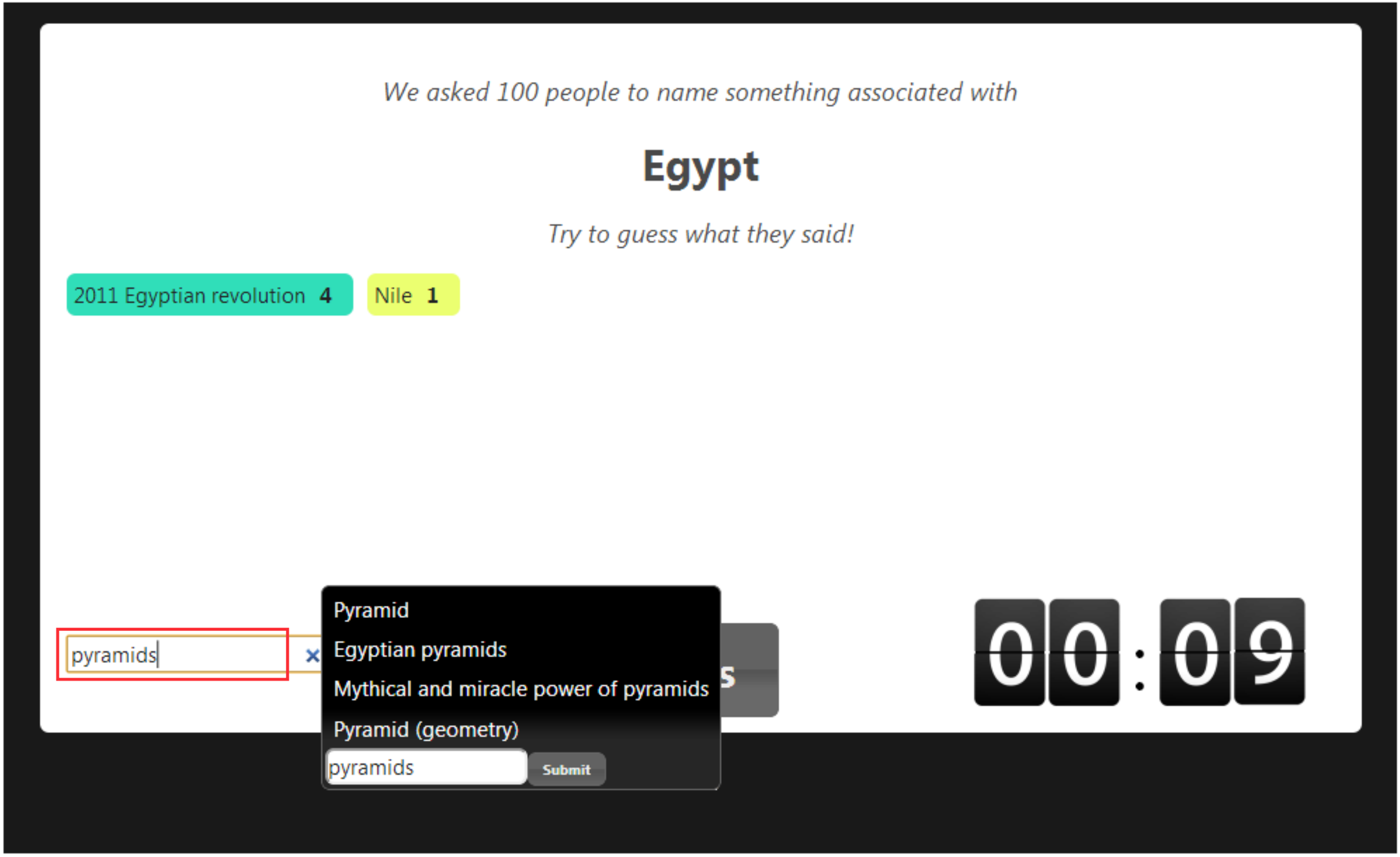

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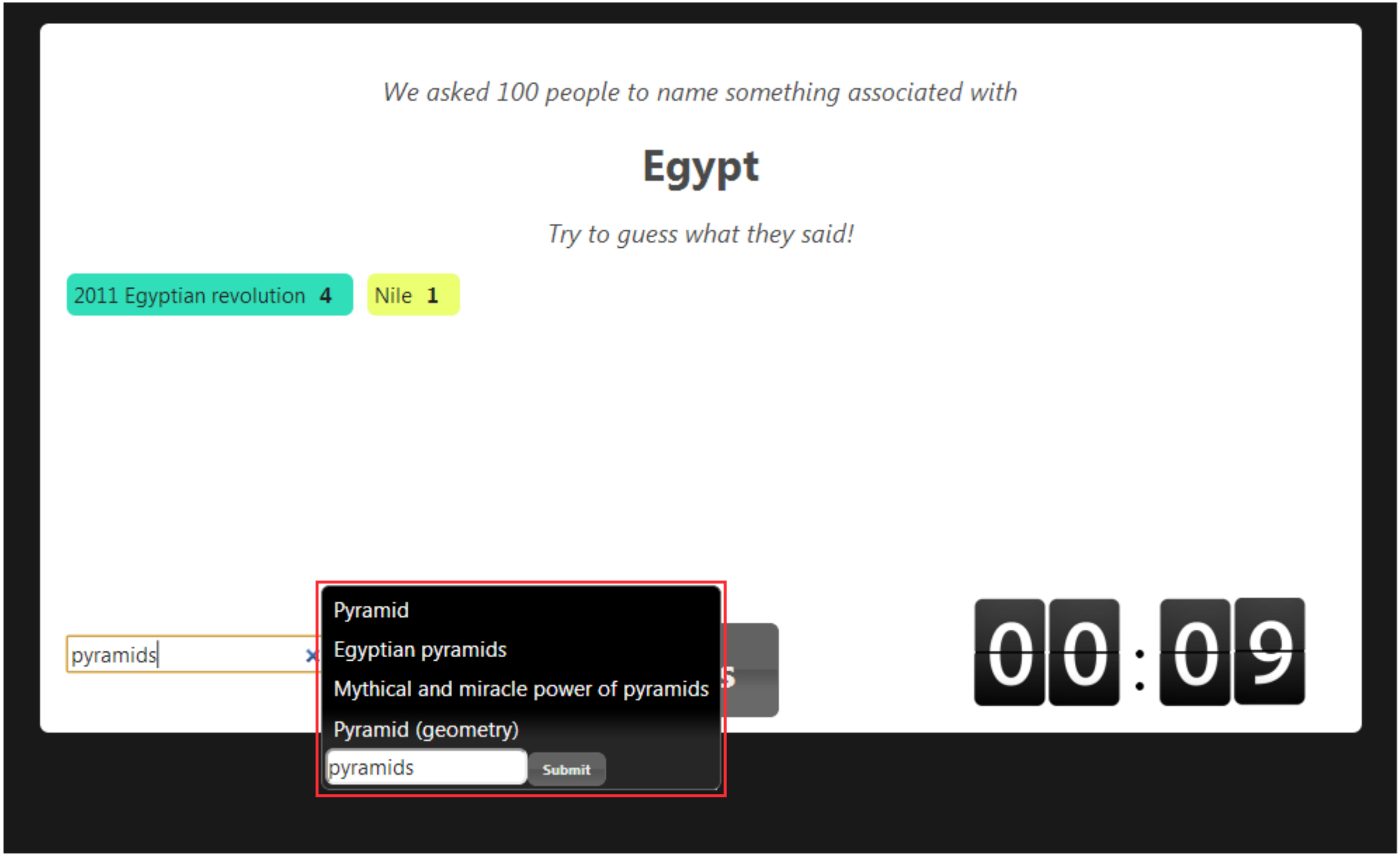

Knowledge Test Game: Walkthrough

We asked 100 people to name something associated with

Egypt

Try to guess what they said!

2011 Egyptian revolution **4** Nile **1**

pyramids

Pyramid
Egyptian pyramids
Mythical and miracle power of pyramids
Pyramid (geometry)
pyramids Submit

00:09

Knowledge Test Game: Walkthrough

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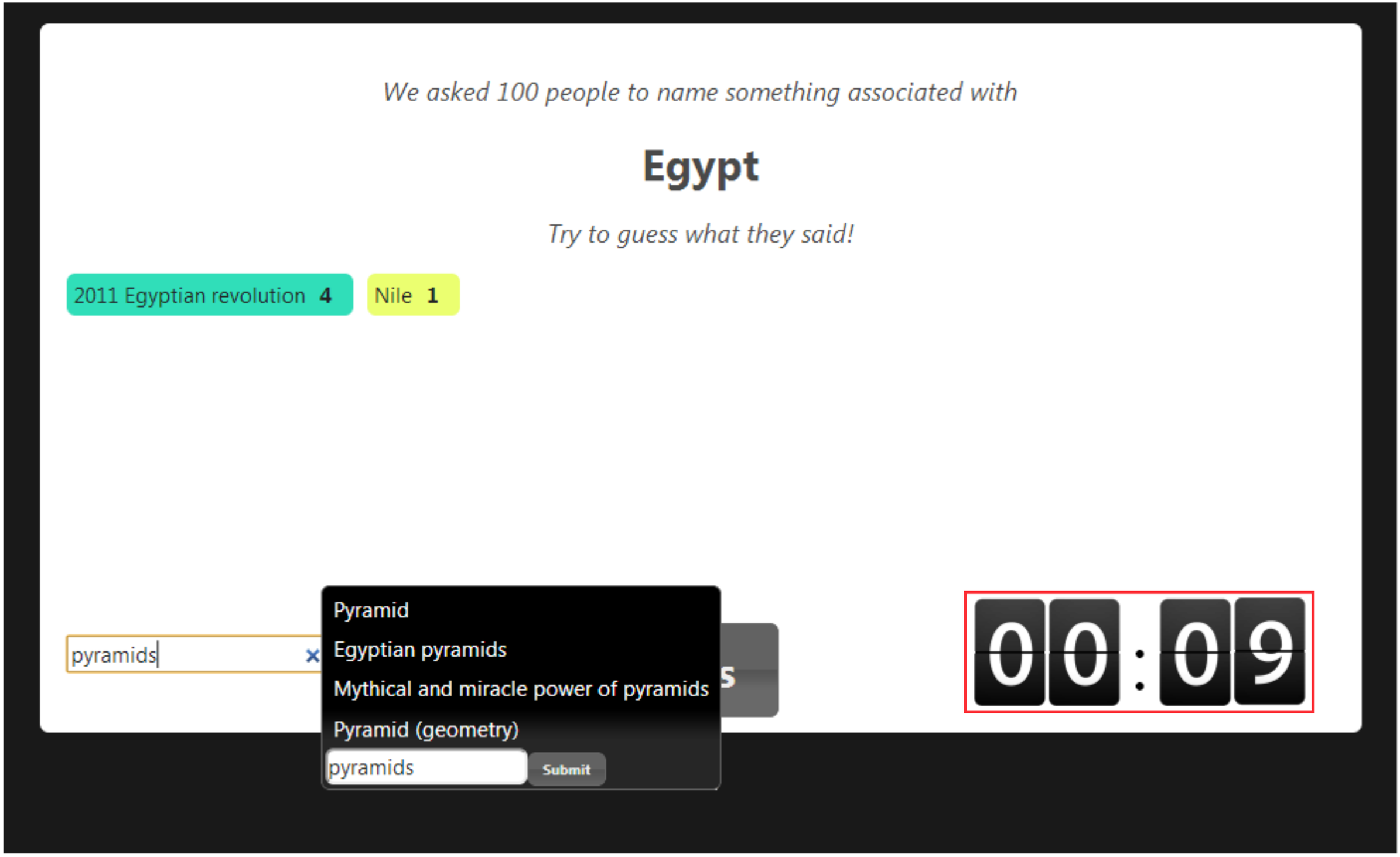

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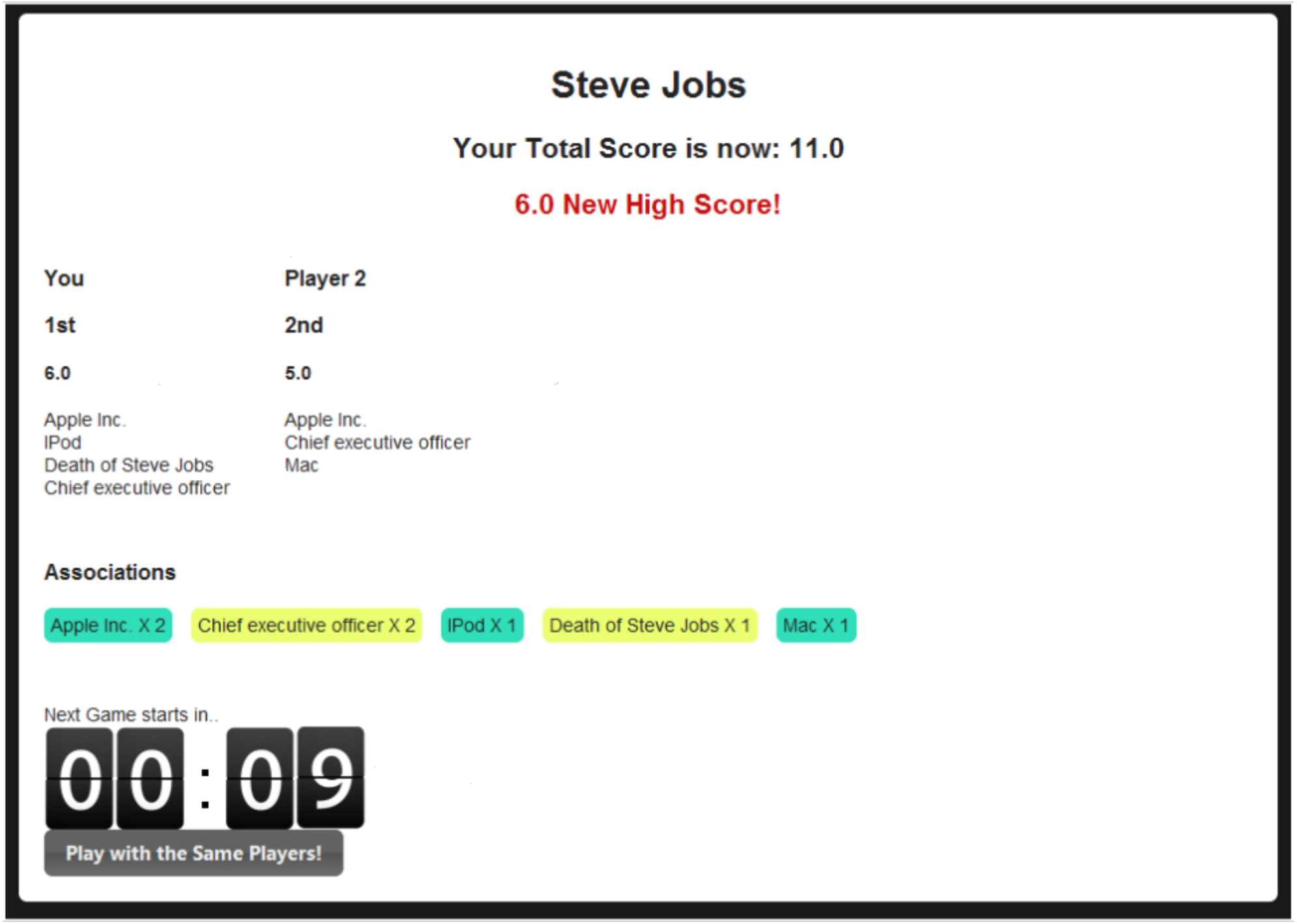
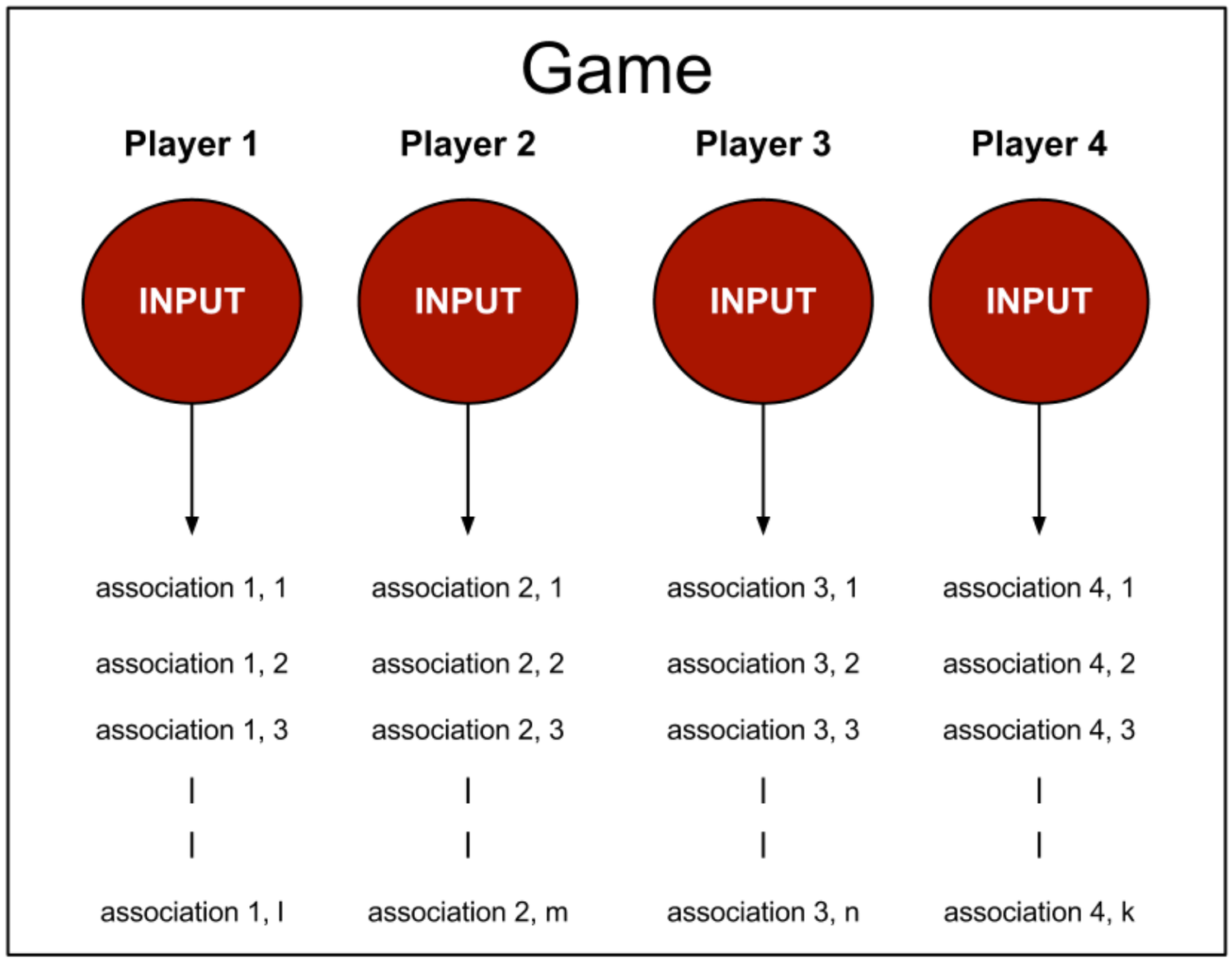


Knowledge Test Game: Walkthrough

Knowledge Test Game: Output Agreement GWAP



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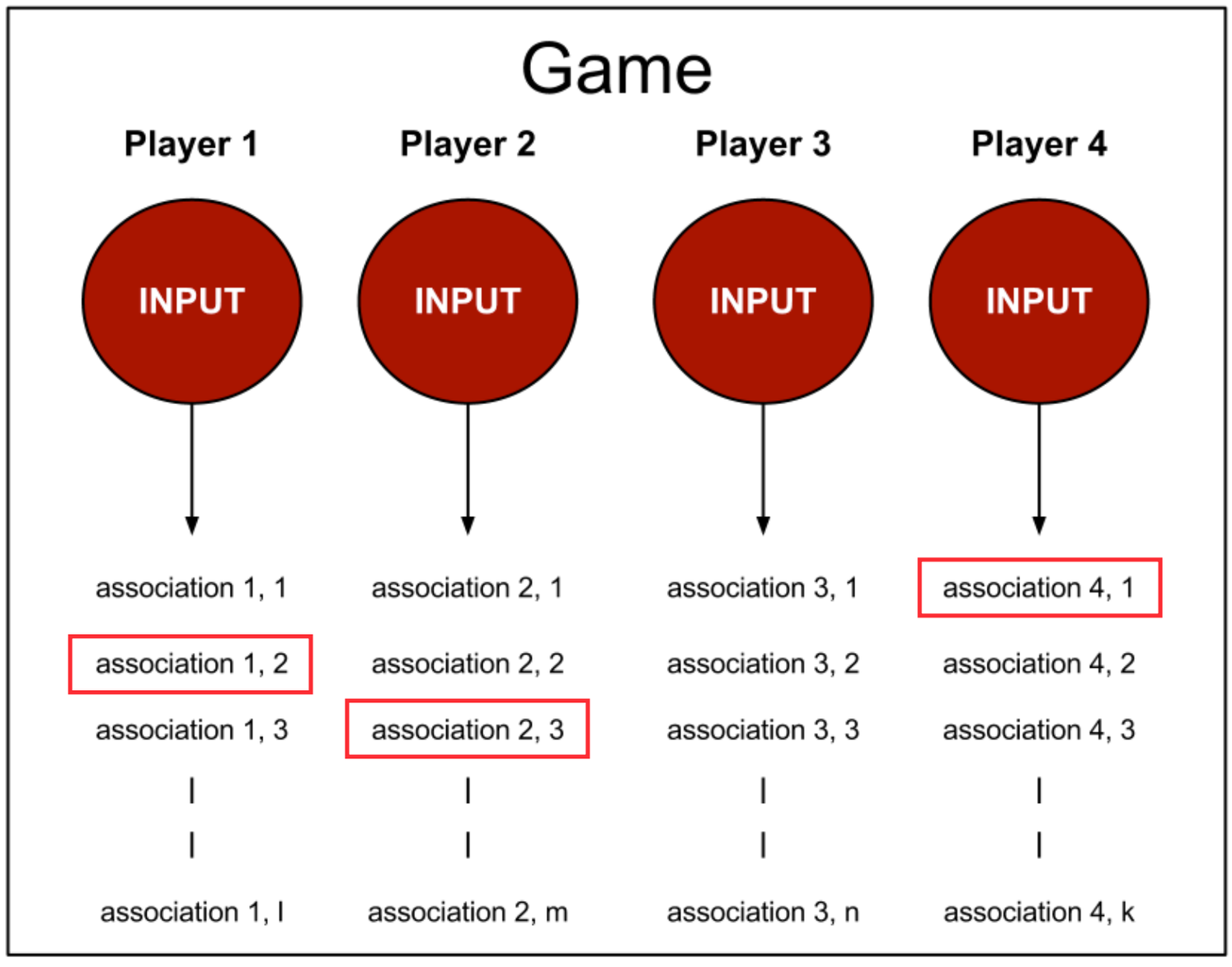
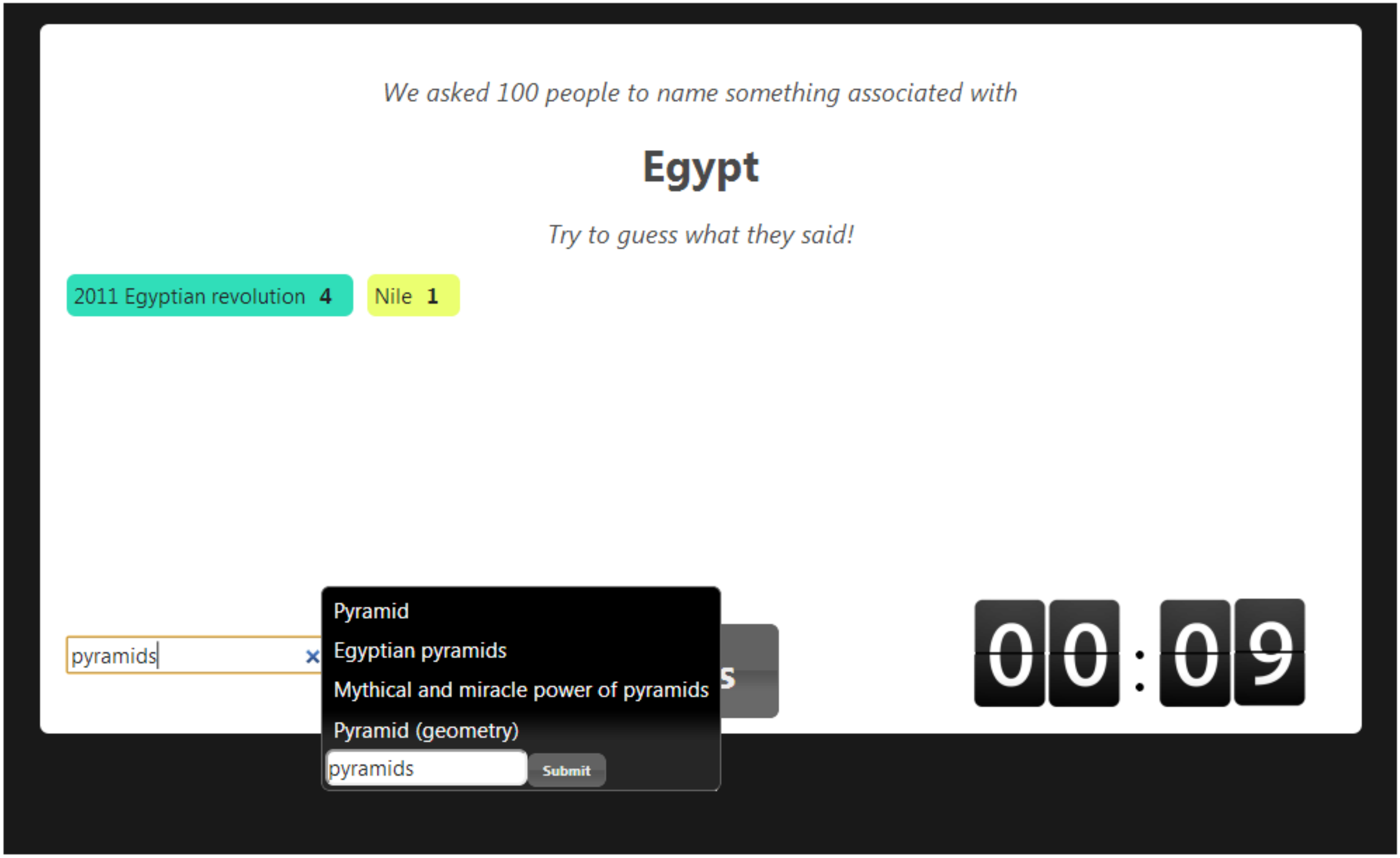


Knowledge Test Game: Suggestions-Box



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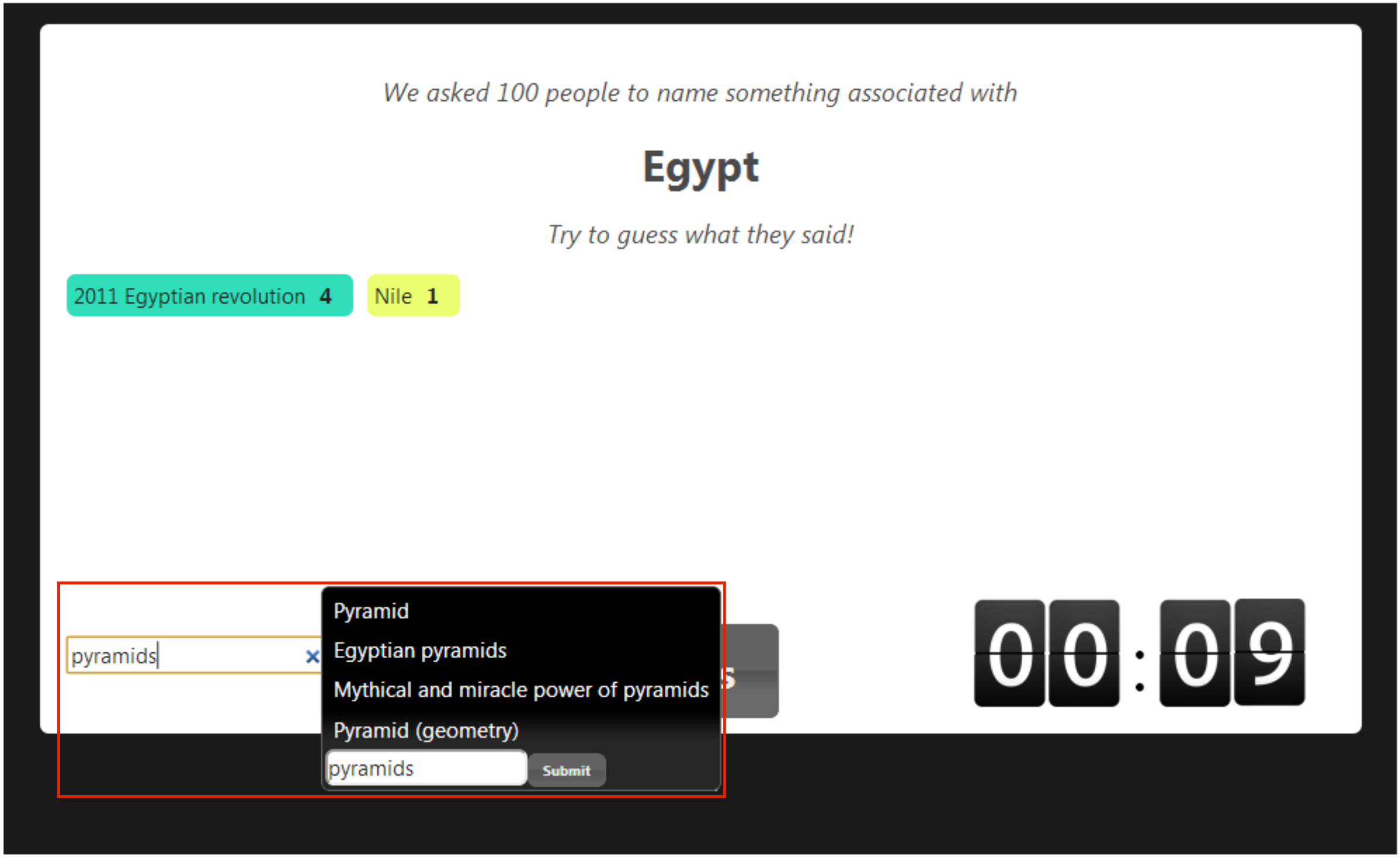

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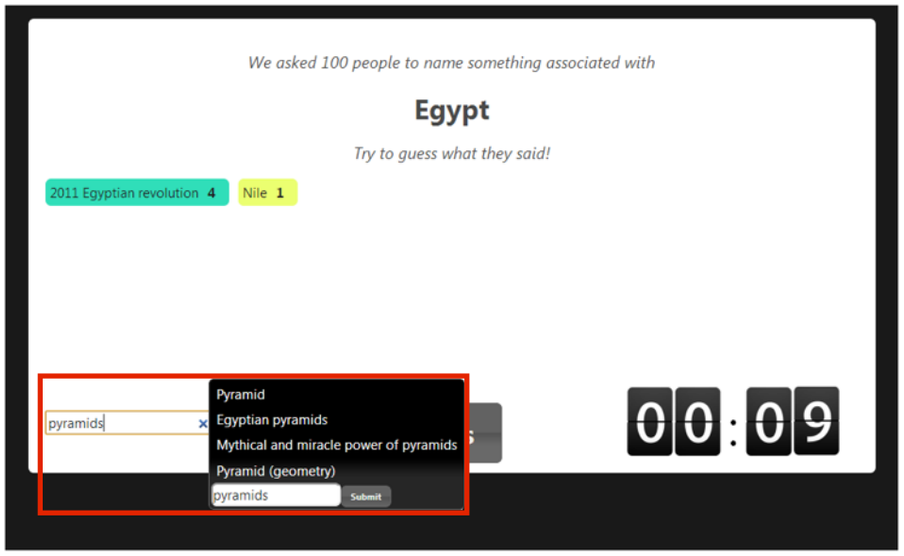

- Collected Gold Standard:
  - 32 topics
  - 9 participants
  - 224 associations
  - mapped to Wikipedia articles (correspond to DBpedia Semantic Entities)

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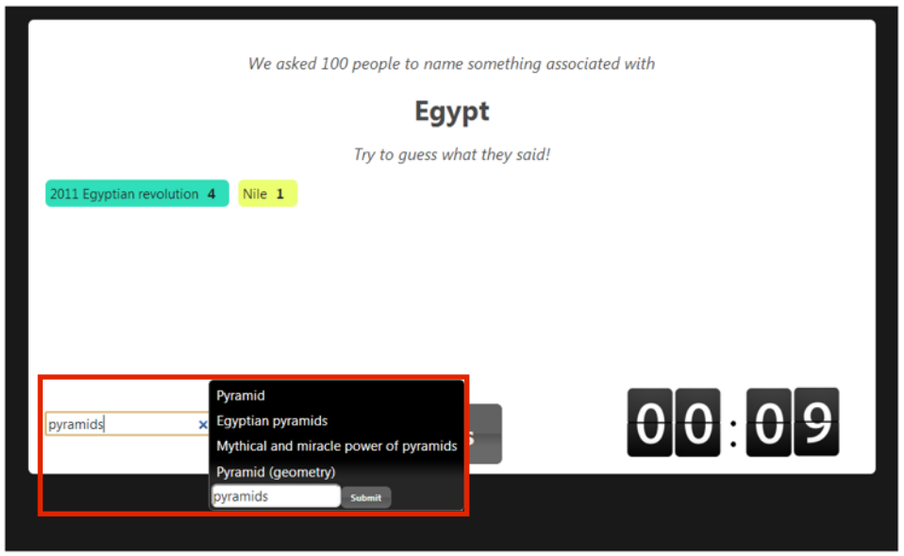

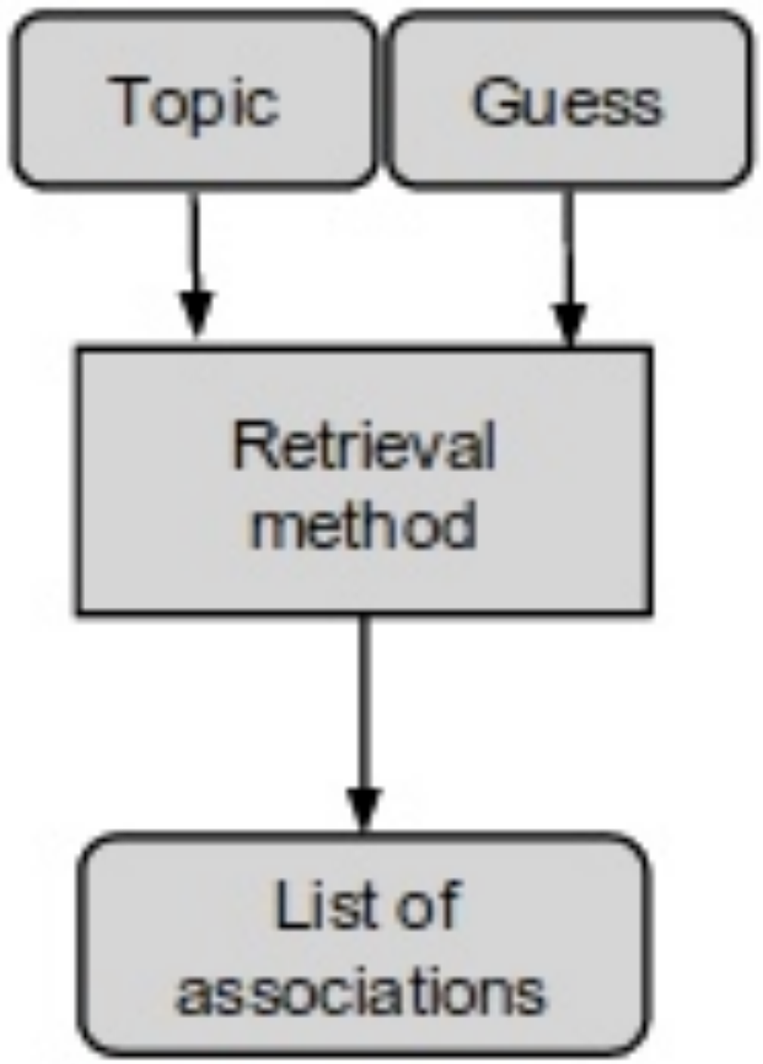

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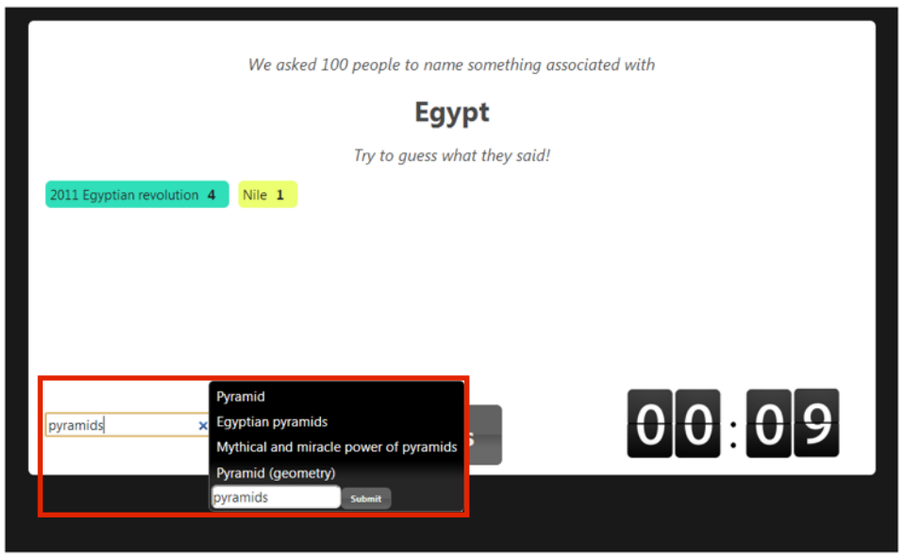

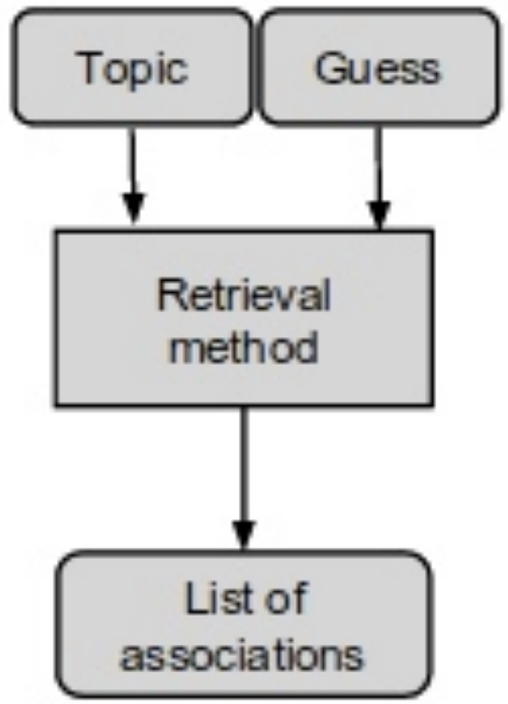

	Mean Recall @ 10	Mean Game Playability @ 10
DBpedia Spotlight	26 %	30 %
Freebase	34 %	39 %
Bing	40 %	49 %
Google	50 %	60 %

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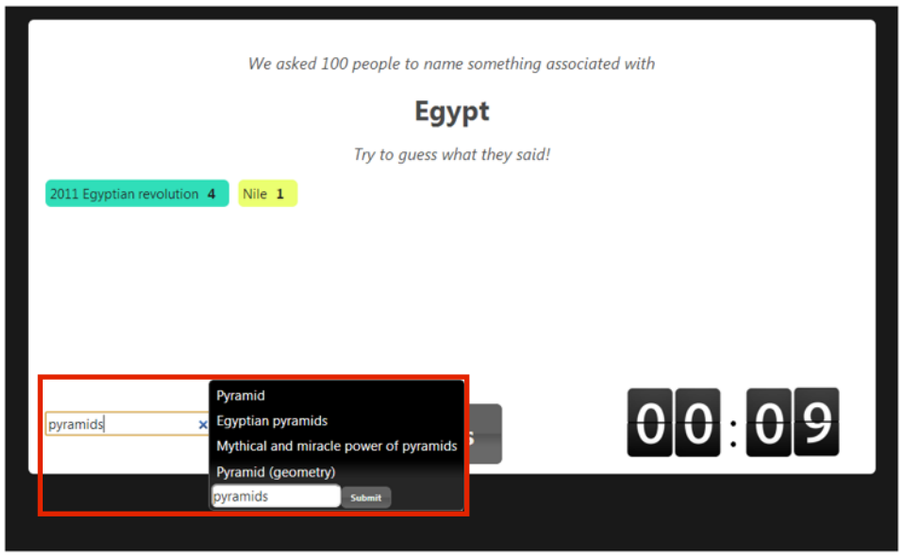

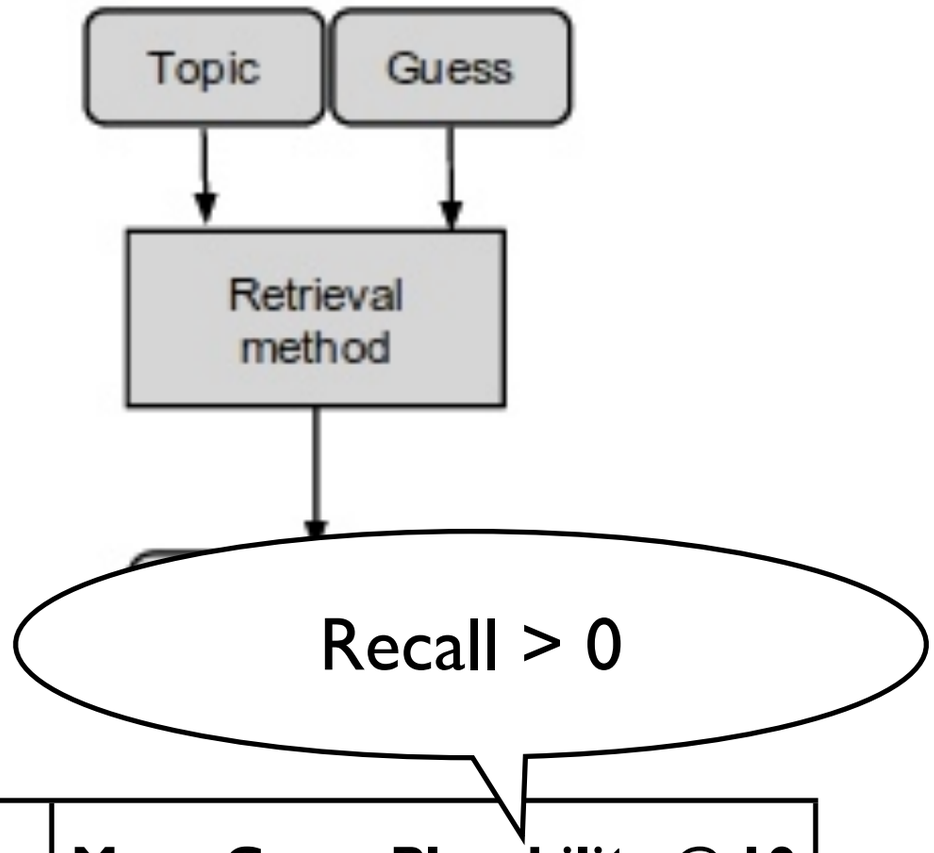

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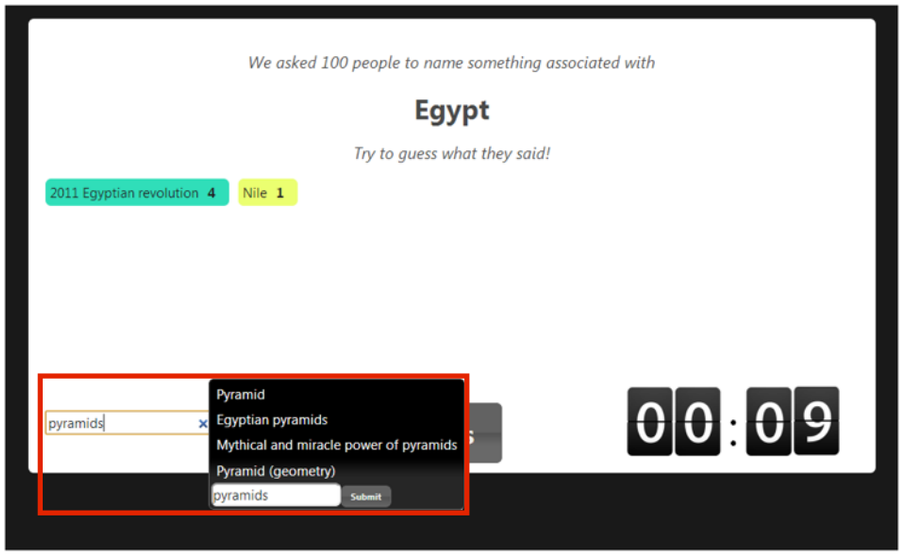

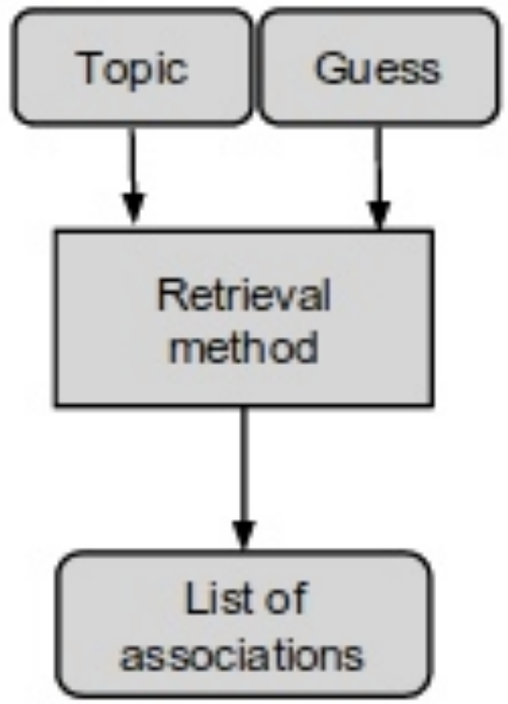

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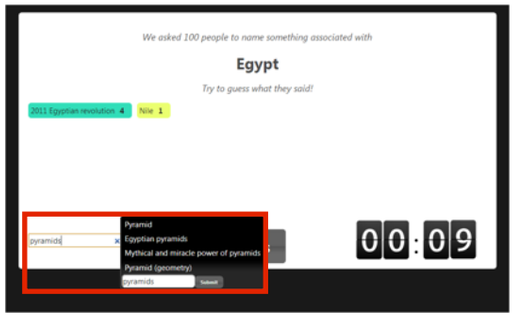

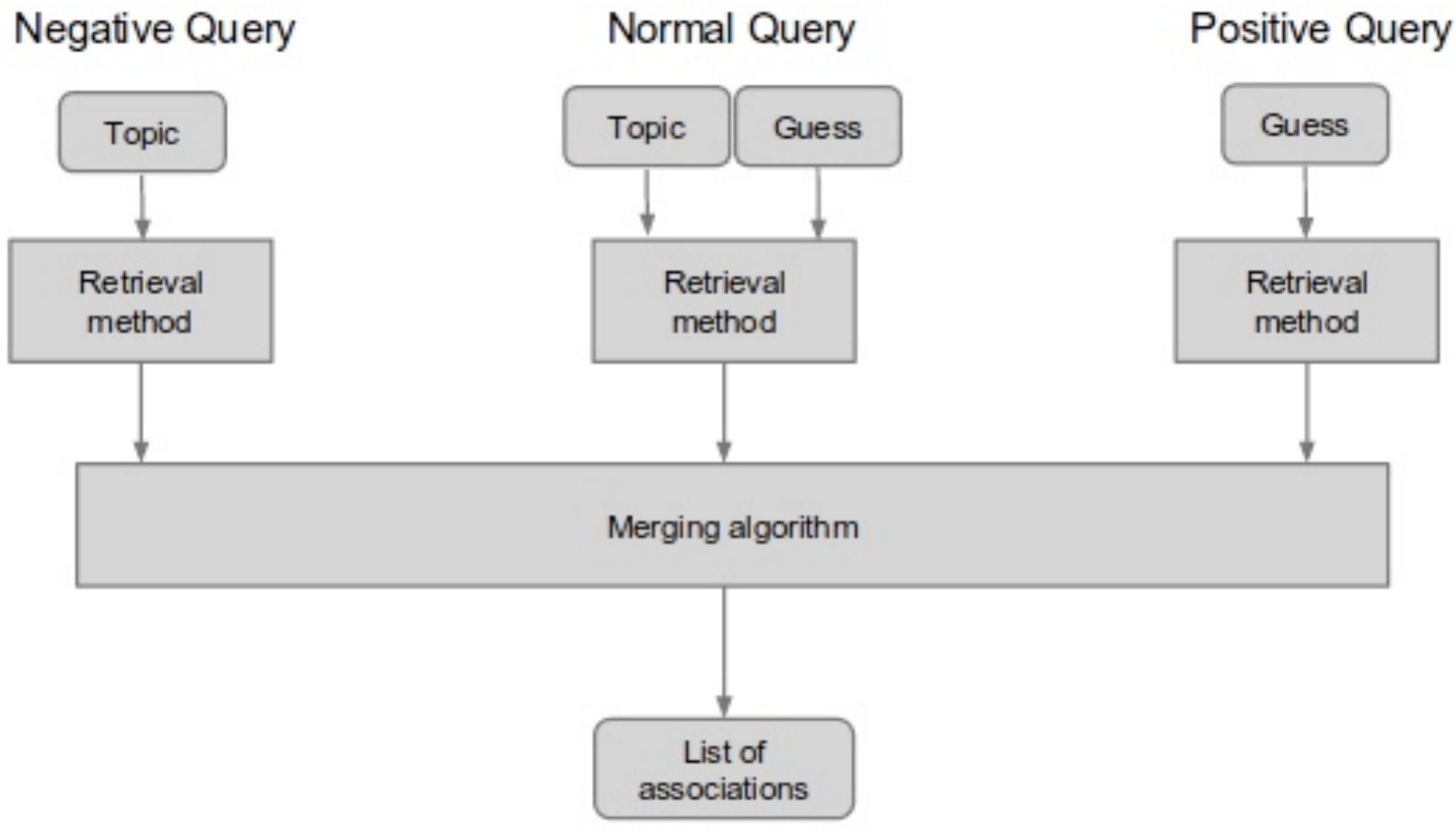

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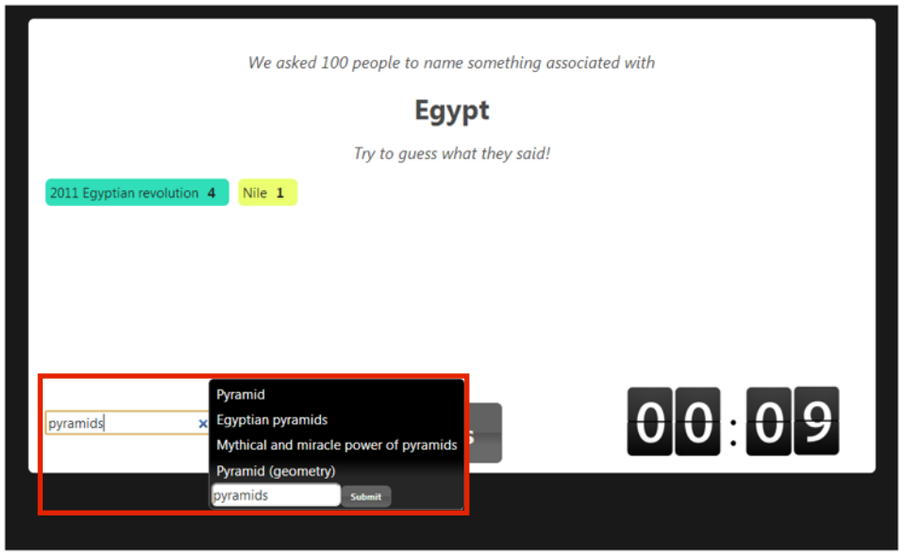
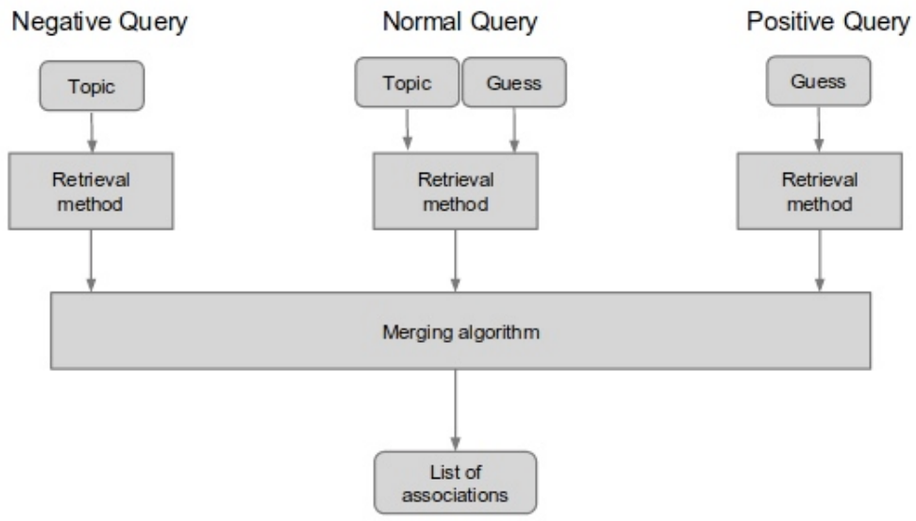
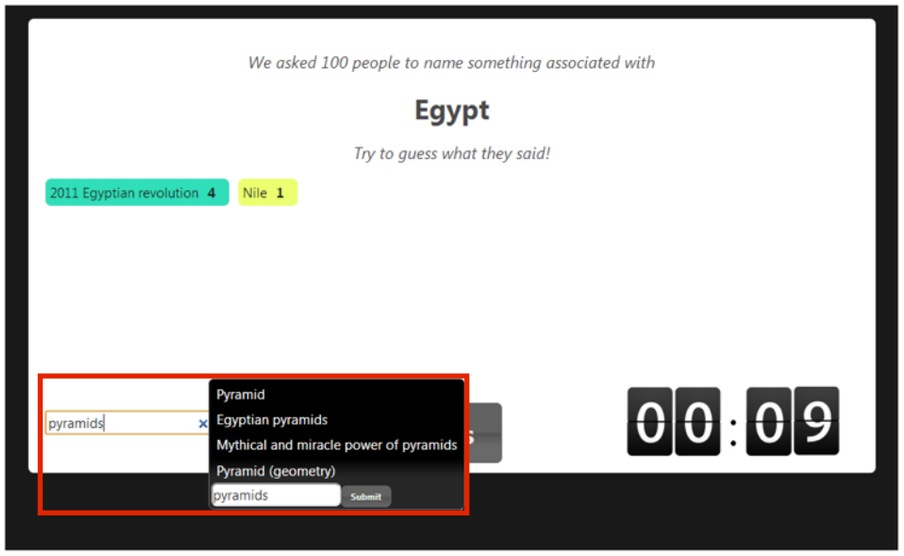
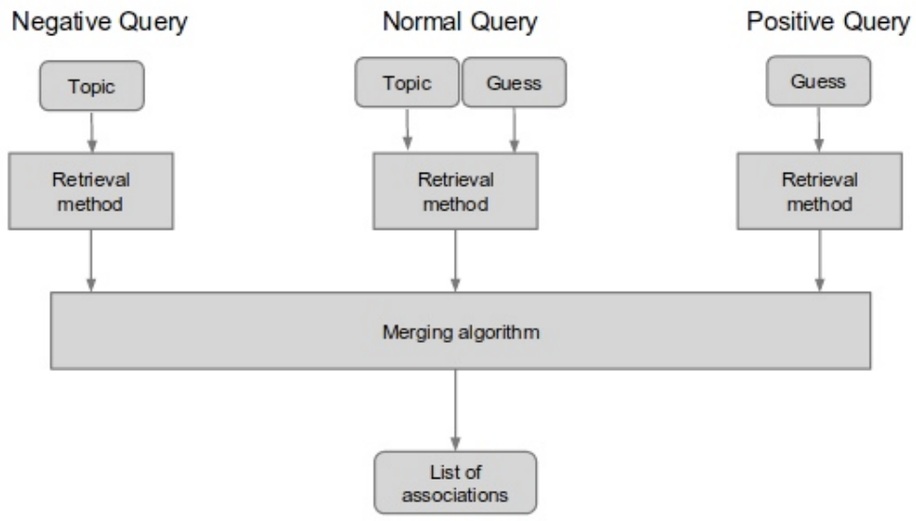




	Mean Recall @ 10	**Mean Game Playability @ 10**
Bing	71.3 %	77.6 %
Google	79.8 %	85.5 %
Google + Bing	80.4 %	86.5 %

Knowledge Test Game: Suggestions-Box





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Bing	71.3 %	77.6 %
Google	79.8 %	85.5 %
Google + Bing	80.4 %	86.5 %

Knowledge Test Game: Suggestions-Box Power

Knowledge Test Game: Suggestions-Box Power

Knowledge Test Game: Suggestions-Box Power

We asked 100 people to name something associated with

Egypt

Try to guess what they said!

german university in cairo
list of arab universities
german-jordanian university
education in egypt
list of universities in egypt
file:karte elite universitäten deutschl...
list of hospitals in egypt
file:guc flags 300.gif
university of bonn
file:gju logo.svg

الجامعة الألمانية

Submit

الجامعة الألمانية

00:03

Knowledge Test Game: Suggestions-Box Power

We asked 100 people to name something associated with

Egypt

Try to guess what they said!

magles el sha3b

- people's assembly of egypt
- majlis al shura
- people's council of syria
- bani assad
- hossein rezazadeh
- religion in iran
- list of classical pianists
- constitution of the islamic republic of...

magles el sha3b Submit

00:14

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- Collected data:
  - 6882 associations
  - 1046 games
  - 267 players
  - 26.6 human hours

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- Collected data:
  - 6882 associations
  - 1046 games
  - 267 players
  - 26.6 human hours
- Example Result:
  - :Mark_Zuckerberg

Association	Mentioned
:Facebook	50
:The_Social_Network	15
:Chief_Executive_Officer	12
:Rich	8
:Millionaire	7

Eval: Game Questionnaire

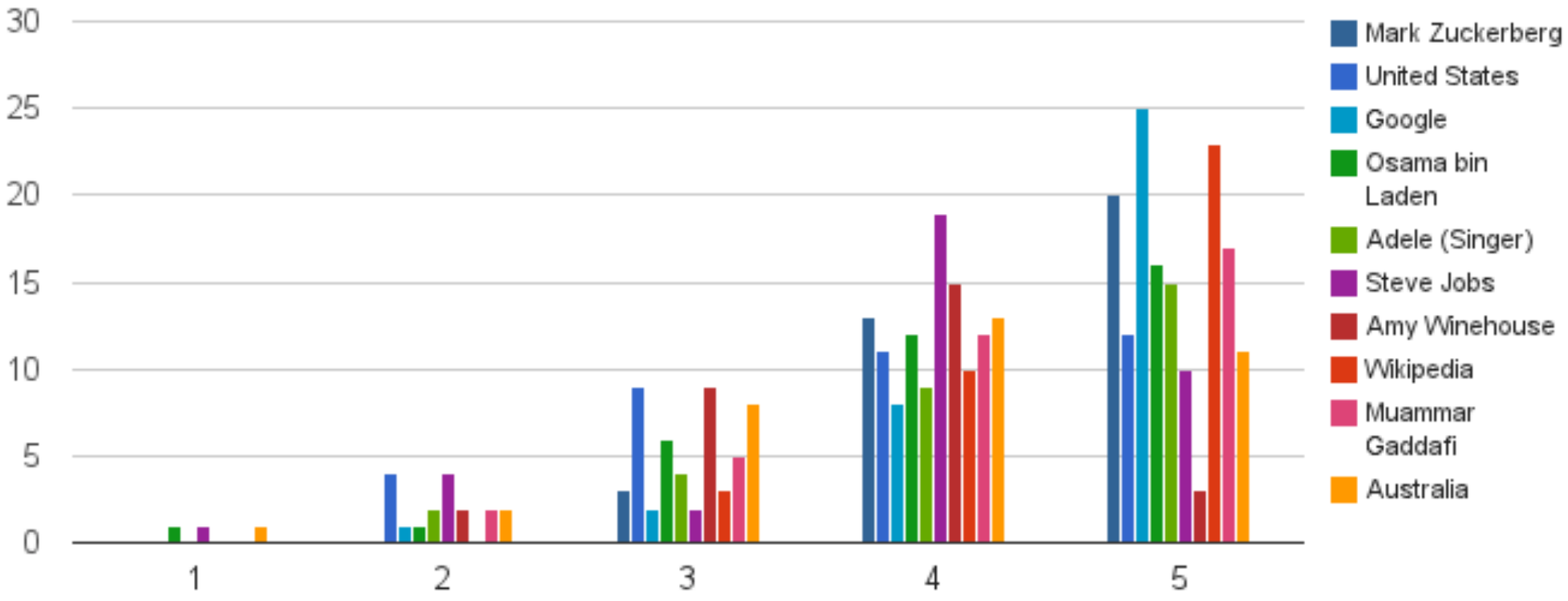
- Summarizing: very positive
- Astonished by the suggestions-box

Eval: Game Questionnaire

- Summarizing: very positive
- Astonished by the suggestions-box
- Influenced future guesses
  - Lead us to reduce amount from 10 to 4

Eval: Data Quality 1

- Results for 10 topics graded by 36 people
- 5 point likert scale: 1 worst, 5 best



Eval: Data Quality II

- Results for Top 9 topics manually sorted
- Aggregation is our Gold Standard

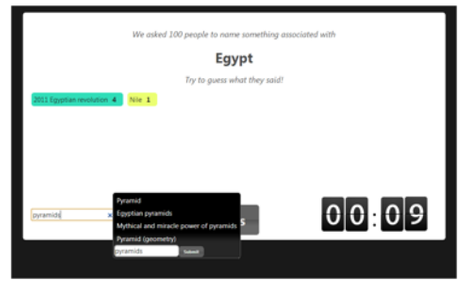
Topic	Top-N Associations	Manual sorting	nDCG Game
Charlie Sheen	8	7 participants	0.969
Eminem	11	14 participants	0.931
Lady Gaga	18	9 participants	0.924
Mark Zuckerberg	7	15 participants	0.954
Osama bin Laden	12	7 participants	0.835
Transformers: Dark of the Moon	18	6 participants	0.926
United Kingdom	14	7 participants	0.873
World War II	17	17 participants	0.953
YouTube	10	17 participants	0.928
		μ	0.921
		σ	0.042

Eval: Data Quality II

- Results for Top 9 topics manually sorted
- Aggregation is our Gold Standard
- Also compared Game's sorting vs. NGD

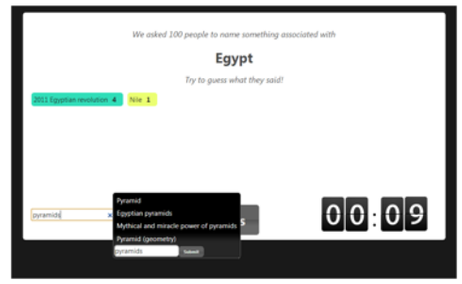
Topic	Top-N Associations	Manual sorting	nDCG NGD	nDCG Game
Charlie Sheen	8	7 participants	0.860	0.969
Eminem	11	14 participants	0.870	0.931
Lady Gaga	18	9 participants	0.806	0.924
Mark Zuckerberg	7	15 participants	0.895	0.954
Osama bin Laden	12	7 participants	0.814	0.835
Transformers: Dark of the Moon	18	6 participants	0.768	0.926
United Kingdom	14	7 participants	0.806	0.873
World War II	17	17 participants	0.876	0.953
YouTube	10	17 participants	0.927	0.928
		μ	0.847	0.921
		σ	0.051	0.042

Summary



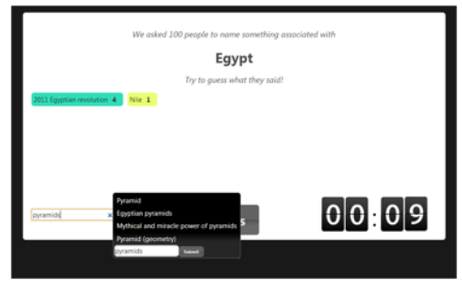
- Knowledge Test Game
- Collects Associations between Semantic Entities
- Powerful Suggestion-box (Bing & Google)

Summary



- Knowledge Test Game
- Collects Associations between Semantic Entities
- Powerful Suggestion-box (Bing & Google)
- Game outperforms simple co-occurrence based similarity metrics

Summary



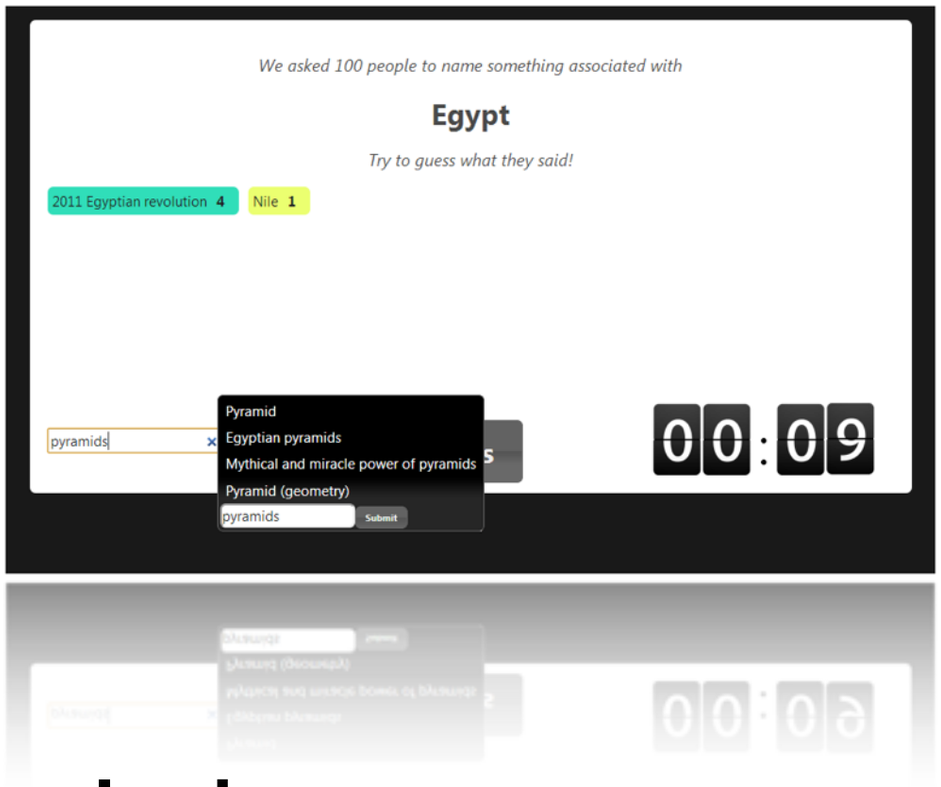
- Knowledge Test Game
- Collects Associations between Semantic Entities
- Powerful Suggestion-box (Bing & Google)
- Game outperforms simple co-occurrence based similarity metrics
- Data online: http://knowledgetestgame.org/export

Outlook

- Provide collected data as Linked Data
- Show most intuitive type in suggestions
- Single player mode
- Enhance fun factor

Discussion

Thanks for your attention



http://knowledgetestgame.org(/export)

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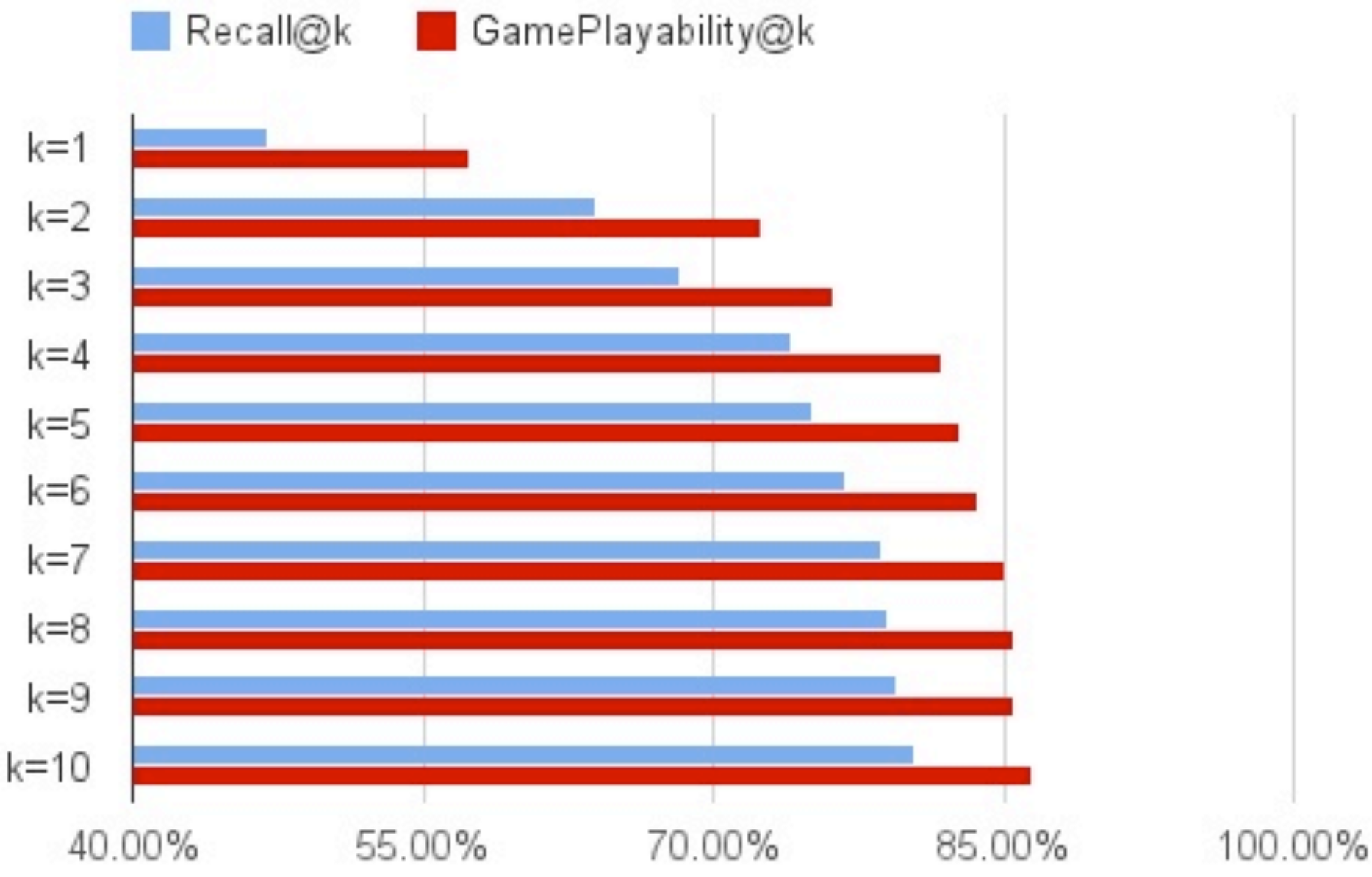
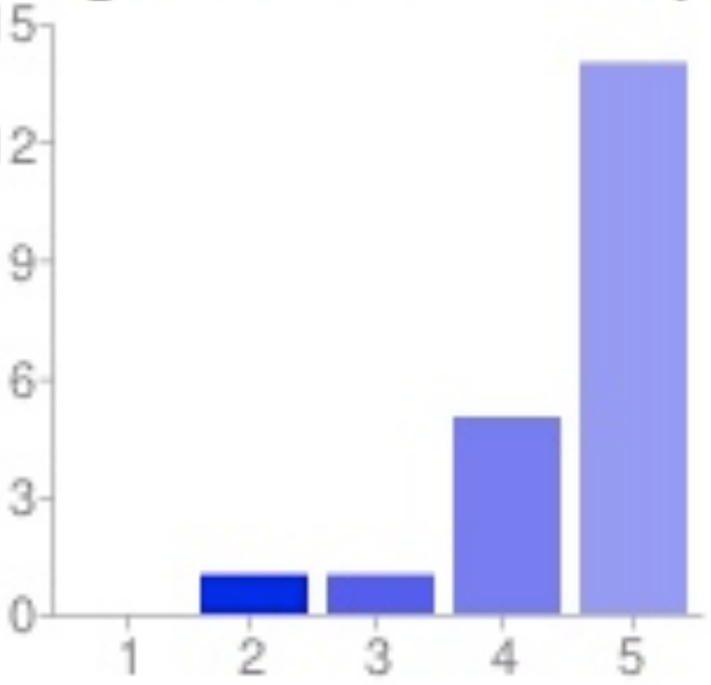
Recall, GP @ k


Recall@k
GamePlayability@k
k=1
k=2
k=3
k=4
k=5
k=6
k=7
k=8
k=9
k=10
40.00%
55.00%
70.00%
85.00%
100.00%

Eval - Stats

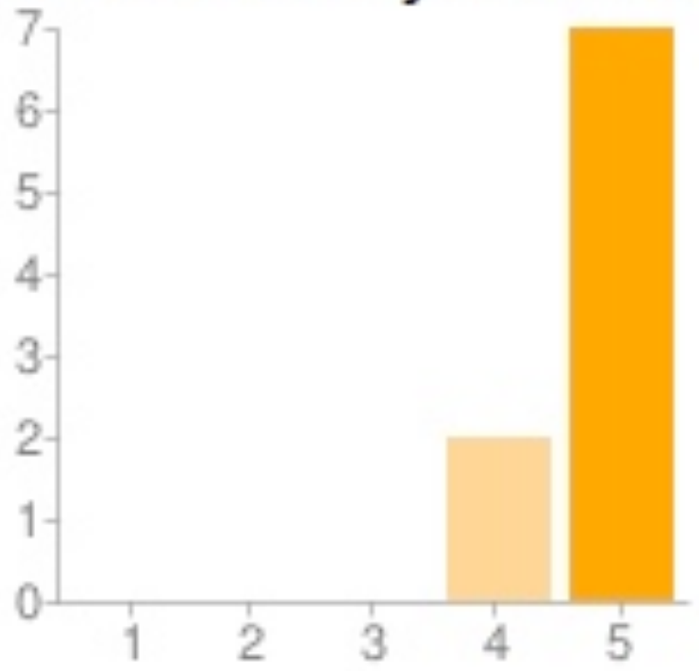
- Collected data:
  - 6882 associations
  - 1046 games
  - 267 players
  - 26.6 human hours
- Throughput:
  - ~ 259 association / h (50 players / day: 310 800)
- Average Lifetime Play:
  - ~ 6 min / p
  - ~ 8 games / p
- Expected Contribution:
  - ~ 26 sem. associations / p

The game rules and concept were direct and straight forward (easily understandable).



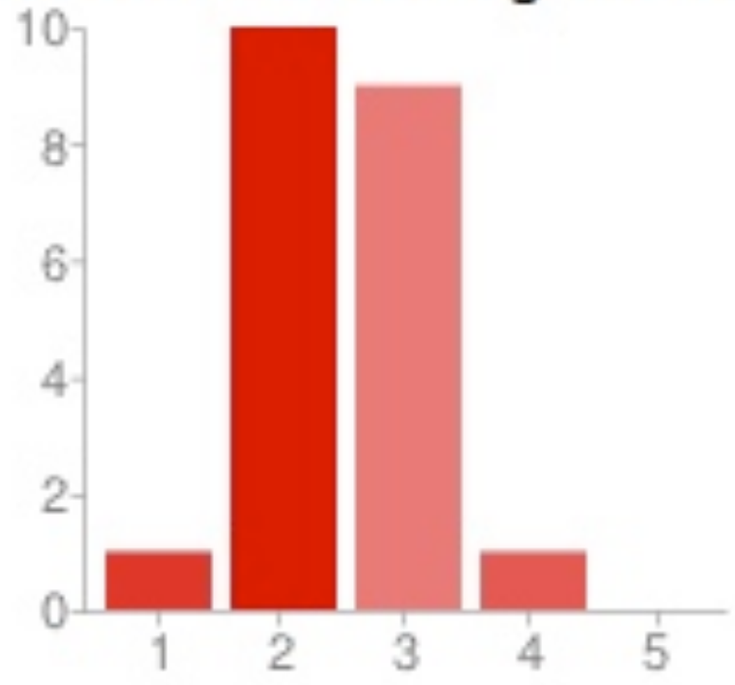
1 -Strongly Disagree	**0**	0%
2	**1**	5%
3	**1**	5%
4	**5**	24%
5 -Strongly Agree	**14**	67%

The How To Play tutorial was..



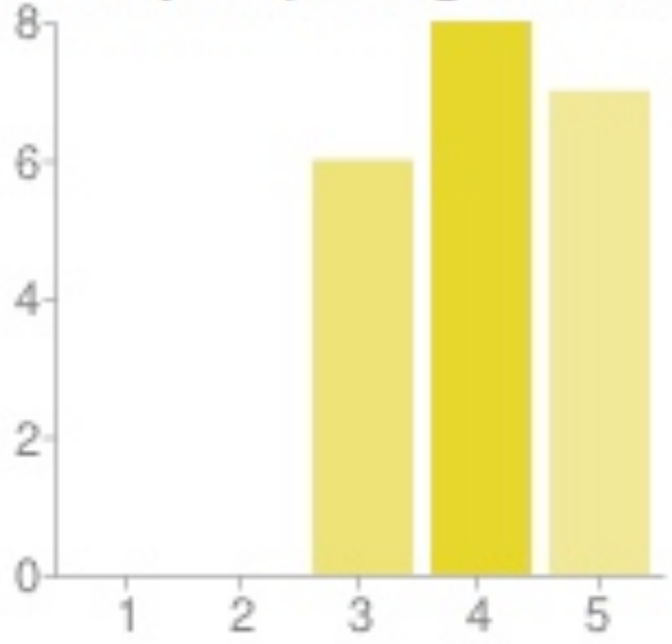
1 -	Useless	**0**	0%
2		**0**	0%
3		**0**	0%
4		**2**	10%
5 -	Useful	**7**	33%

45 seconds for the game were...



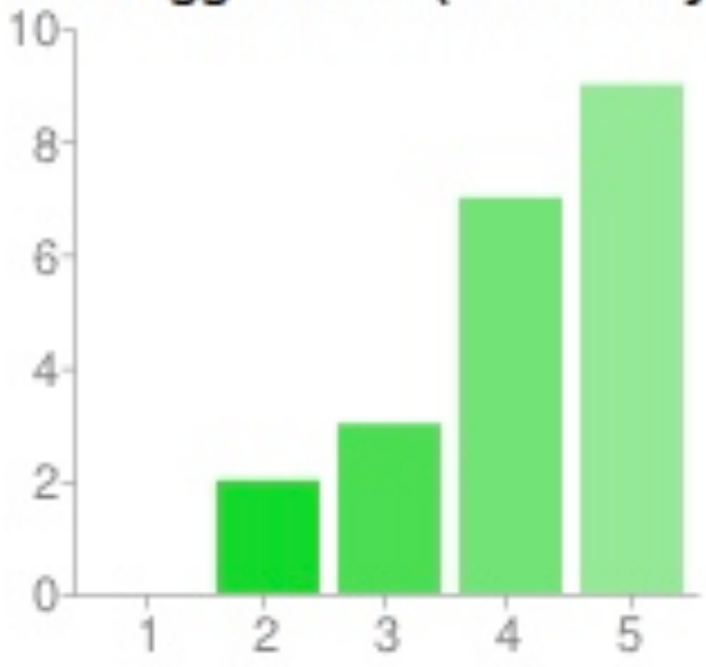
1 -Too short	**1**	5%
2	**10**	48%
3	**9**	43%
4	**1**	5%
5 -Too long	**0**	0%

The topics (the big name in each game) were clear and known to me.



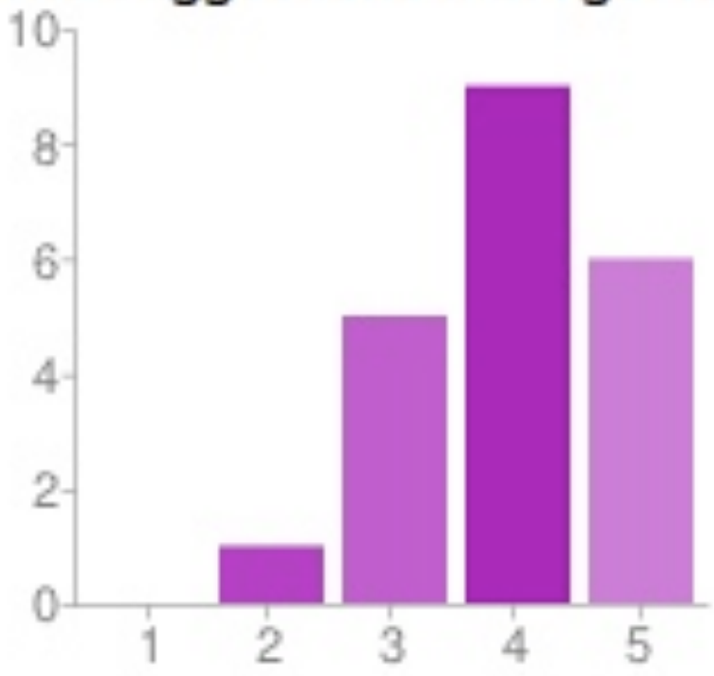
1 -Strongly Disagree	**0**	0%
2	**0**	0%
3	**6**	29%
4	**8**	38%
5 -Strongly Agree	**7**	33%

The suggestions (the ones you get upon hitting enter) were relevant to what I had in mind.



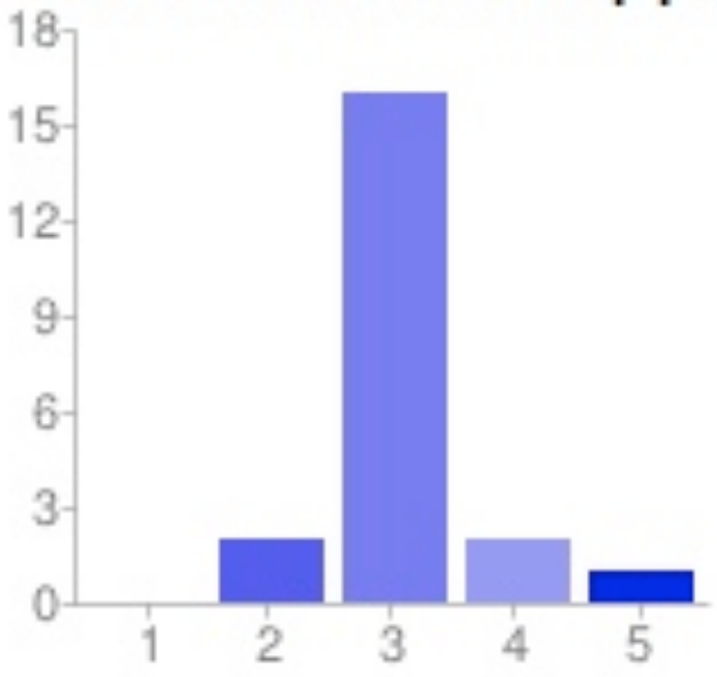
1 -Strongly Disagree	**0**	0%
2	**2**	10%
3	**3**	14%
4	**7**	33%
5 -Strongly Agree	**9**	43%

The suggestions that I got for a guess influenced my following guesses.



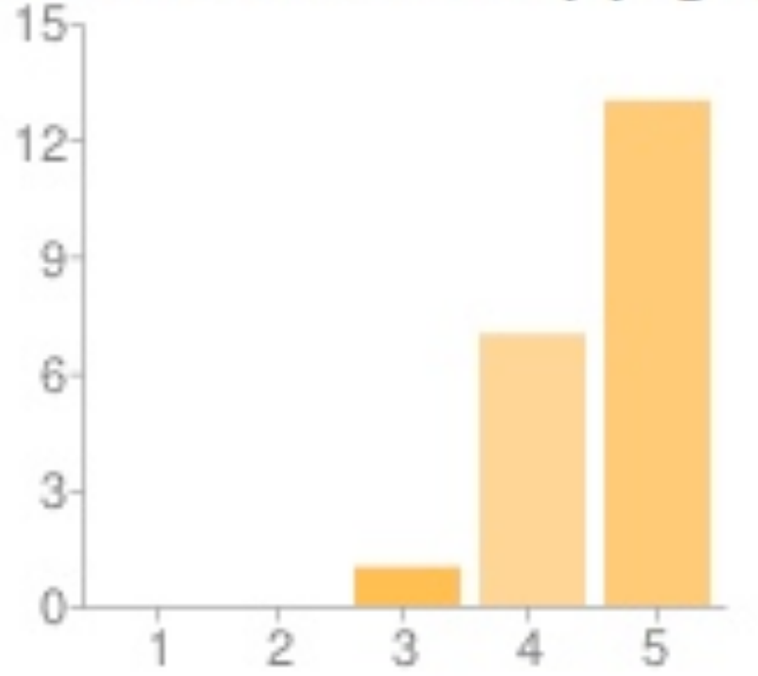
1 -Strongly Disagree	**0**	0%
2	**1**	5%
3	**5**	24%
4	**9**	43%
5 -Strongly Agree	**6**	29%

15 seconds for the recap page were...



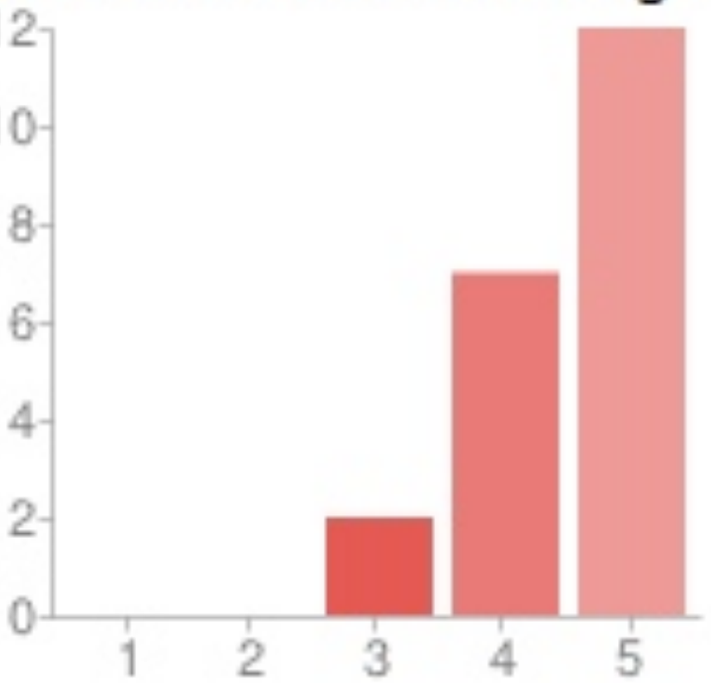
1 - too short	**0**	0%
2	**2**	10%
3	**16**	76%
4	**2**	10%
5 - too long	**1**	5%

I understood the recap page (The page with the scores).



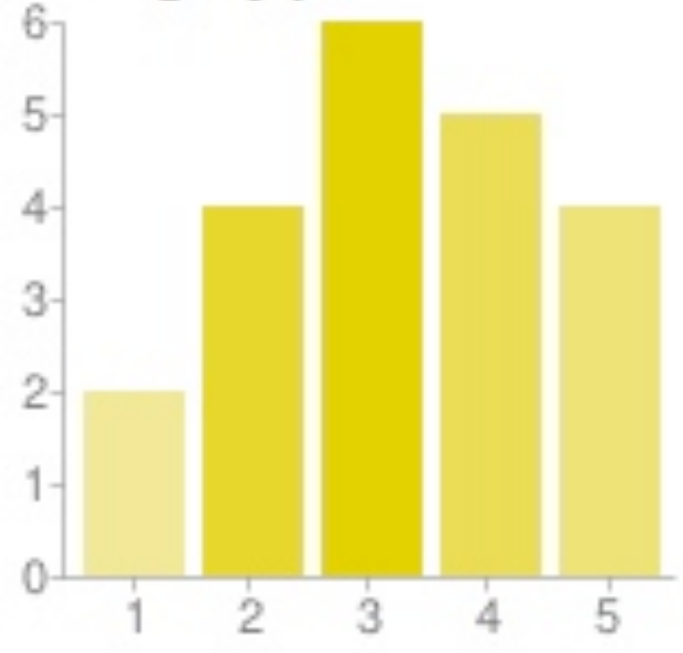
1 -Strongly Disagree	**0**	0%
2	**0**	0%
3	**1**	5%
4	**7**	33%
5 -Strongly Agree	**13**	62%

I was interested in reading the scores in the recap page.



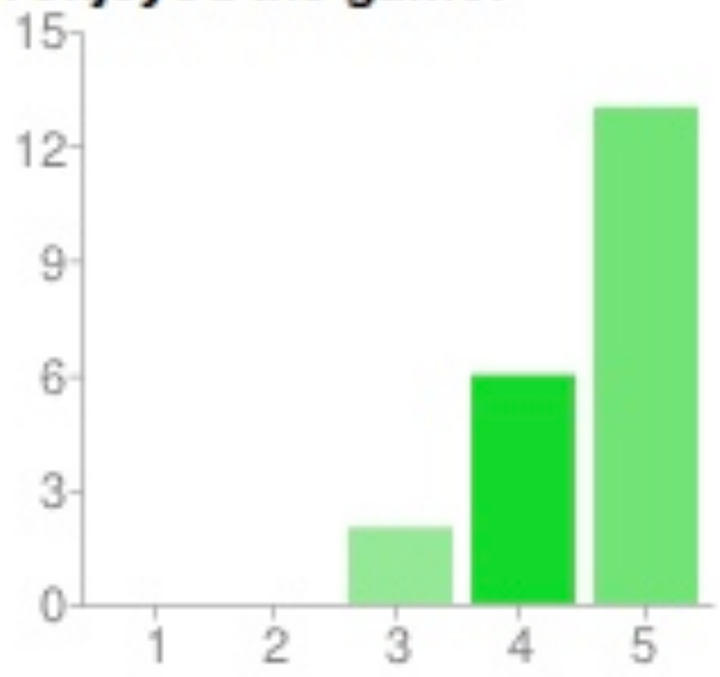
1 -Strongly Disagree	**0**	0%
2	**0**	0%
3	**2**	10%
4	**7**	33%
5 -Strongly Agree	**12**	57%

Seeing my partners' answers influenced my guesses in the following games.



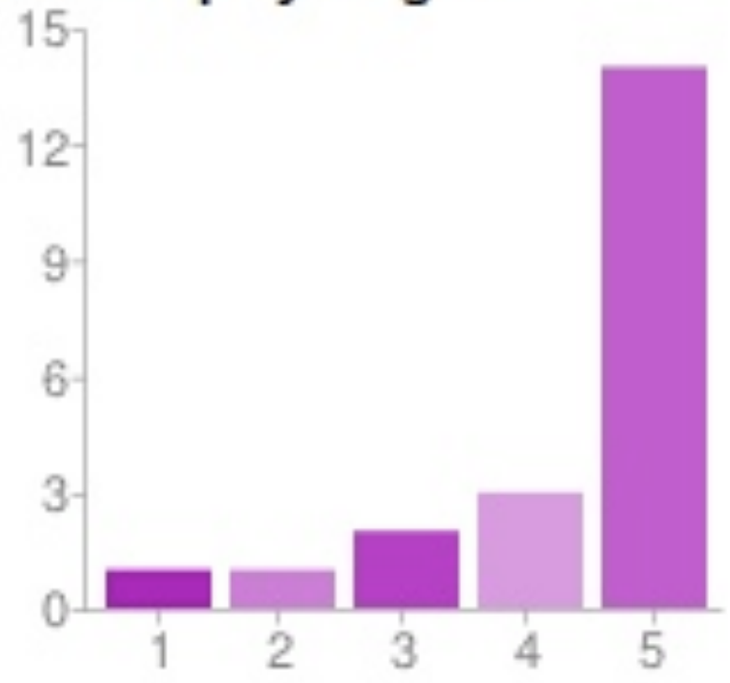
1 -Strongly Disagree	**2**	10%
2	**4**	19%
3	**6**	29%
4	**5**	24%
5 -Strongly Agree	**4**	19%

I enjoyed the game.



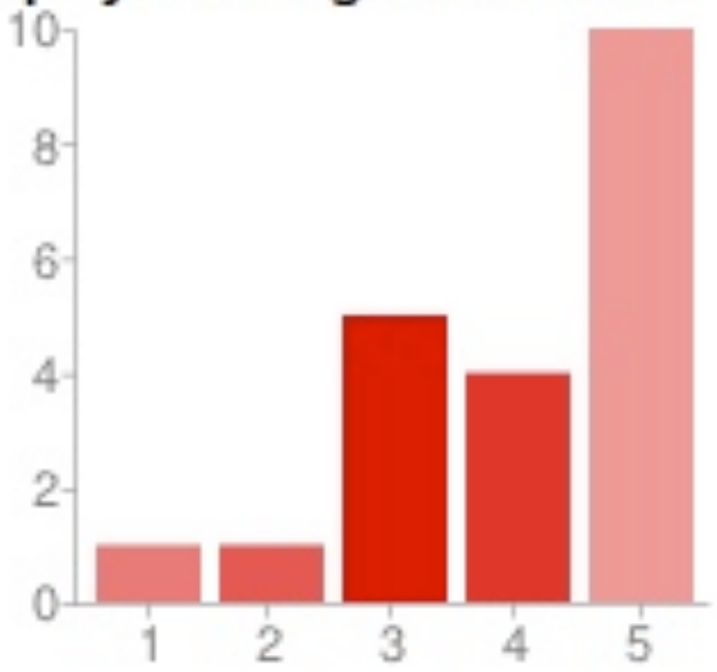
1 -Strongly Disagree	**0**	0%
2	**0**	0%
3	**2**	10%
4	**6**	29%
5 -Strongly Agree	**13**	62%

I would play it again.



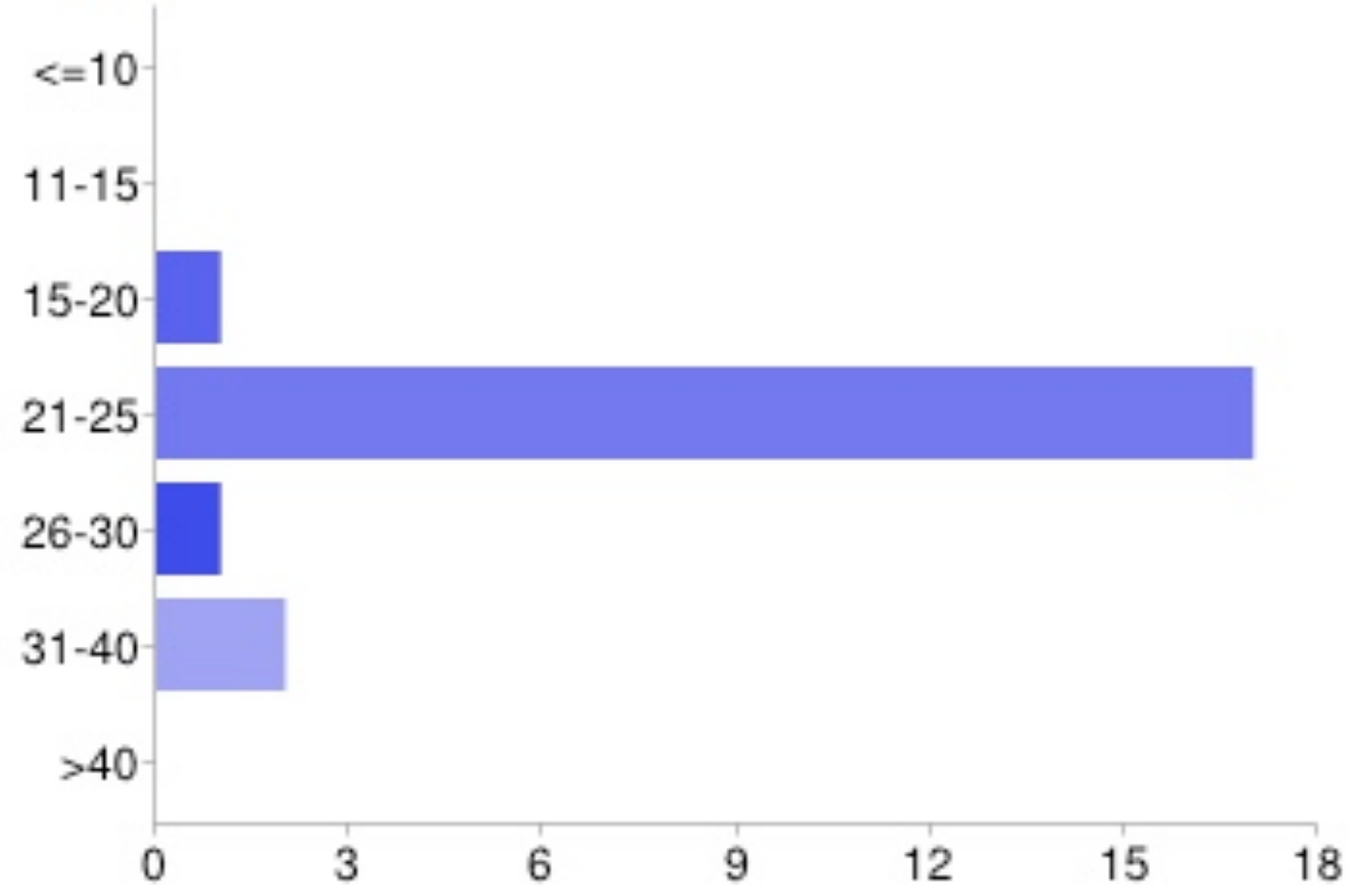
1 -Strongly Disagree	**1**	5%
2	**1**	5%
3	**2**	10%
4	**3**	14%
5 -Strongly Agree	**14**	67%

I played web games before.



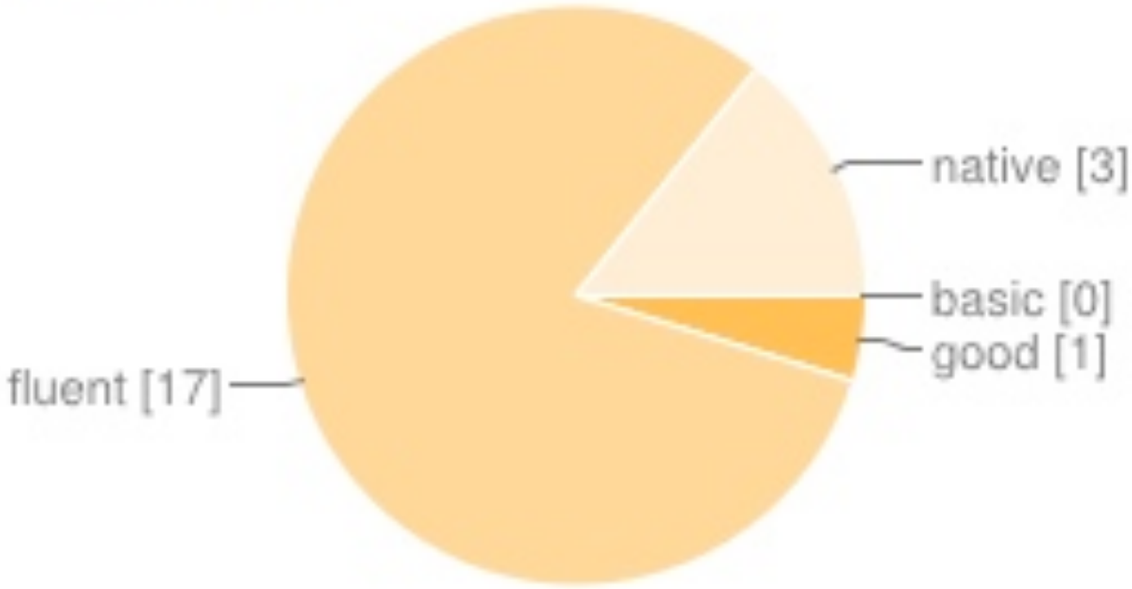
1 -	Never	**1**	5%
2		**1**	5%
3		**5**	24%
4		**4**	19%
5 -	A lot	**10**	48%

My age:



<=10	**0**	0%
11-15	**0**	0%
15-20	**1**	5%
21-25	**17**	81%
26-30	**1**	5%
31-40	**2**	10%
>40	**0**	0%

My English skills are...



basic	**0**	0%
good	**1**	5%
fluent	**17**	81%
native	**3**	14%