University of Zurich[UZH]

Institut für Computerlinguistik

Cost-effectiveness of Games with a Purpose

Module «Crowdsourcing für Sprachtechnologie»

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Defining the object of investigation

Interested in the cost-effectiveness (CE) of software that

- is a game with a purpose (GWAP)
- makes users produce linguistically enriched data

How many NLP GWAP are there?

Defining the object of investigation

Interested in the cost-effectiveness (CE) of software that

- is a game with a purpose (GWAP)
- makes users produce linguistically enriched data

How many NLP GWAP are there?

A comprehensive list of GWAP in published literature

1001 Paraphrases (Chklovski, 2005)
FaCtory (Chamberlain et al., 2013)
Categorilla (Vickrey et al., 2008)
Categodzilla (Vickrey et al., 2008)
PlayCoref (Hladká et al., 2009)
PackPlay (Chamberlain et al., 2013)
GIVE (Chamberlain et al., 2013)
OntoGame (Siorpaes and Hepp, 2008)
Knowledge Towers (Vannella et al., 2014)
Puzzle Racer (Jurgens and Navigli, 2014)
JDM-pt (Mangeot and Ramisch, 2012)
Metropol Italia (Bry et al., 2013)
Kaboom! (Jurgens and Navigli, 2014)
An (unfortunately) unnamed game
in Pearl and Steyvers (2010)

LEARNER (Chamberlain et al., 2013)
Verbosity (von Ahn et al., 2006)
Free Association (Vickrey et al., 2008)
Phrase Detectives (Poesio et al., 2013)
PhraTris (Attardi, 2010)
Sentiment Quiz (Scharl et al., 2012)
JeuxDeMots (Lafourcade and Joubert, 2008)
Infection (Vannella et al., 2014)
SuchGame (Chamberlain et al., 2013)
ColorIt (Lafourcade et al., 2014)
OnToGalaxy (Krause et al., 2010)
Doodling (Kumaran et al., 2014)
Wordrobe (Venhuizen et al., 2013)

An (allegedly) complete list of GWAP that

- are documented in published literature
- generate a linguistic resource

A more readable list of GWAP for NLP

1001 Paraphrases	FaCtory	Categorilla
Free Association	PlayCoref	PackPlay
GIVE	OntoGame	Knowledge Towers
Puzzle Racer	JDM-pt	Metropol Italia
Kaboom!	LEARNER	Verbosity
Phrase Detectives	PhraTris	Sentiment Quiz
JeuxDeMots	Infection	SuchGame
ColorIt	OnToGalaxy	Wordrobe

Omitted: *Doodling* and the unnamed game from Pearl and Steyvers (2010)

Games that are online and can be played

1001 Paraphrases	FaCtory	Categorilla
Free Association	PlayCoref	PackPlay
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Puzzle Racer	JDM-pt	Metropol Italia
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- online and playable
- difficult to access
- offline

Games that are online and can be played

At least half of the games are offline

- some never got past an experimental alpha phase
- ephemeral, short online presence

Being offline and half-baked is rather detrimental to cost-effectiveness

“Cost” mentioned in published literature

1001 Paraphrases	FaCtory	Categorilla
Free Association	PlayCoref	PackPlay
GIVE	OntoGame	Knowledge Towers
Puzzle Racer	JDM-pt	Metropol Italia
Kaboom!	LEARNER	Verbosity
Phrase Detectives	PhraTris	Sentiment Quiz
JeuxDeMots	Infection	SuchGame
ColorIt	OnToGalaxy	Wordrobe
Doodling	[unnamed game]	

- cost mentioned
- personal communication with author
- no mention

“Cost” mentioned in published literature *and* online

1001 Paraphrases	FaCtory	Categorilla
Free Association	PlayCoref	PackPlay
GIVE	OntoGame	**Knowledge Towers**
Puzzle Racer	JDM-pt	Metropol Italia
Kaboom!	LEARNER	Verbosity
Phrase Detectives	PhraTris	Sentiment Quiz
JeuxDeMots	**Infection**	SuchGame
ColorIt	OnToGalaxy	Wordrobe
Doodling	[unnamed game]	

- cost mentioned, online and playable

“Cost” mentioned in published literature *and* online

Two important observations:

- interestingly, almost all games where cost was mentioned are still online
- in general, neither being online for a long time nor cost are of importance in the literature

How to judge the CE of GWAP when it is only rarely mentioned in the literature?

Gather information about CE of GWAP

Ask researchers directly about cost:

I am wondering whether you have any rough estimate of ***how much money was used to create the game*** *(salary of all people involved, licensing of third-party software, server costs, hardware etc.).*
Jon Chamberlain and colleagues have published similar data for "Phrase Detectives" and I would like to be able to ***compare them****.*

Gather information about CE of GWAP

Ask researchers directly about the value of enriched data:

The users playing your game have generated linguistic data. Do you have a rough estimate of ***how much money it would have cost to obtain the very same data by traditional means*** *(i.e. paying experts for annotation tasks)?*

Gather information about CE of GWAP

Ask researchers directly about the CE:

In the specific case of your game, ***is developing a GWAP a cost-effective approach*** *that "pays off"? Do the gains from your game outweigh the costs?*

Gather information about CE of GWAP

Questions sent to 10 main authors

- Some people went offline along with their games
- Only 5 of them responded, 2 of which are the developers of GWAP that do mention cost

Respondent	**GWAP**
Arno Scharl	Sentiment Quiz
Markus Krause	OnToGalaxy
Mathieu Lafourcade	JeuxDeMots
Johan Bos	Wordrobe
Jon Chamberlain	Phrase Detectives

Some responses

Prof Arno Scharl:

Unfortunately we have collected ***no data whatsoever regarding the economic aspects*** *that you are investigating.*

Some responses

Prof Arno Scharl:

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Prof Johan Bos:

We are ***actually now looking into*** *comparing Wordrobe with other crowd-sourcing methods (such as Crowdflower). Therefore I can't disclose any concrete figures right now.*

Estimating Cost-effectiveness

CE of GWAP as compared to Crowd-sourcing

What do we mean by “cost-effectiveness” of an NLP GWAP?

- purpose: get as much annotated data as possible, given the research budget
- cost-effective if the data it provided **could not have been obtained with less money**

Usually, GWAP are compared against Crowd-sourcing (CS) approaches.

CE of GWAP as compared to Crowd-sourcing

All of them compare against crowd-sourcing:

GWAP	**Cheapest**	**Fastest**
Doodling	GWAP	GWAP
TKT	GWAP	CS
Infection	GWAP	CS
Puzzle Racer	GWAP	CS
JeuxDeMots	GWAP	CS
PD	GWAP	CS

TKT = The Knowledge Towers, CS = Crowd-sourcing, PD = Phrase Detectives

CE of GWAP as compared to Crowd-sourcing

GWAP	Cheapest	Fastest	Formula for Success
Doodling	GWAP	GWAP	short-circuiting player attraction
TKT	GWAP	CS	students did all the work
Infection	GWAP	CS	students did all the work
Puzzle Racer	GWAP	CS	students did all the work
JeuxDeMots	GWAP	CS	longevity, attractiveness
PD	GWAP	CS	longevity, attractiveness

TKT = The Knowledge Towers, CS = Crowd-sourcing, PD = Phrase Detectives

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- Key insight: GWAP is often cost-effective, but slow

The Cost-effectiveness of JeuxDeMots

Finally getting down to numbers

- size of lexical network: 20 million relations between 500 thousand terms
- speed of 1 hypothetical linguist: 6 relations per minute
- cost of said linguist: 30 CHF per hour

Comparing against traditional annotation:

$$20000000 \ / \ 6 = 3300000 \ min = 55555 \ h * 30 \ CHF = \mathbf{1666650 \ CHF}$$

The Cost-effectiveness of JeuxDeMots

Finally getting down to numbers

- size of lexical network: 20 million relations between 500 thousand terms
- cost of annotating a relation by a turker: 0.1 CHF

Comparing against crowd-sourcing:

$$20000000 * 0.1 = \mathbf{2000000\ CHF}$$

The Cost-effectiveness of JeuxDeMots

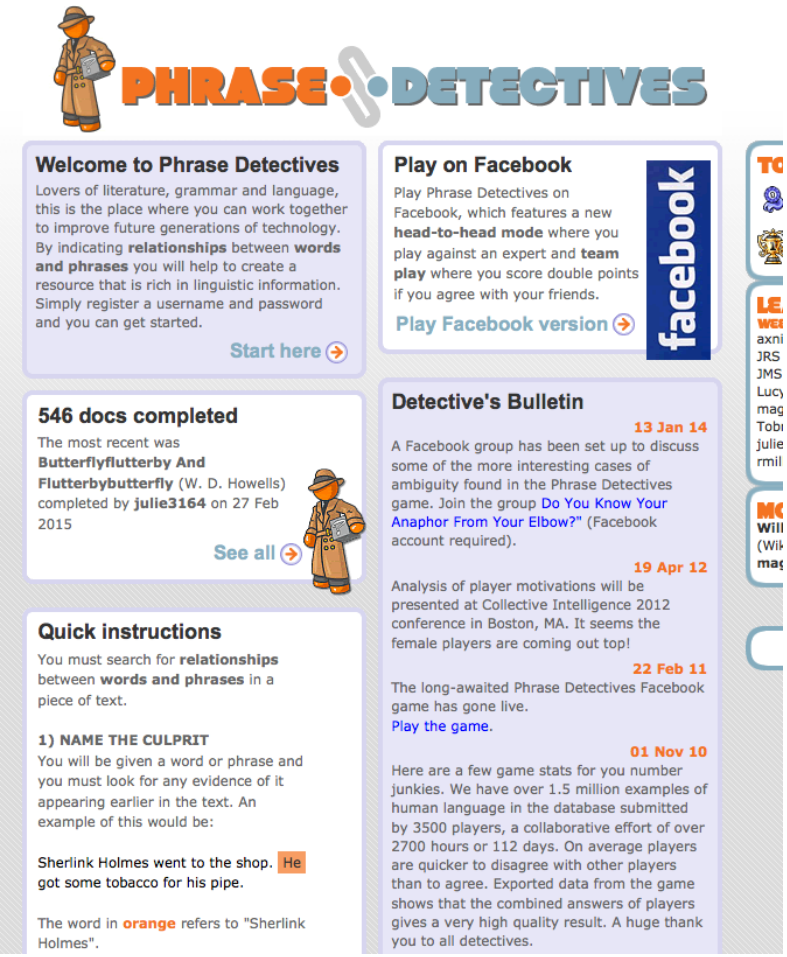
Expert Annotation	1666650	CHF
Crowd-sourcing	2000000	CHF
Actual Total Cost	**> 80000**	**EUR**

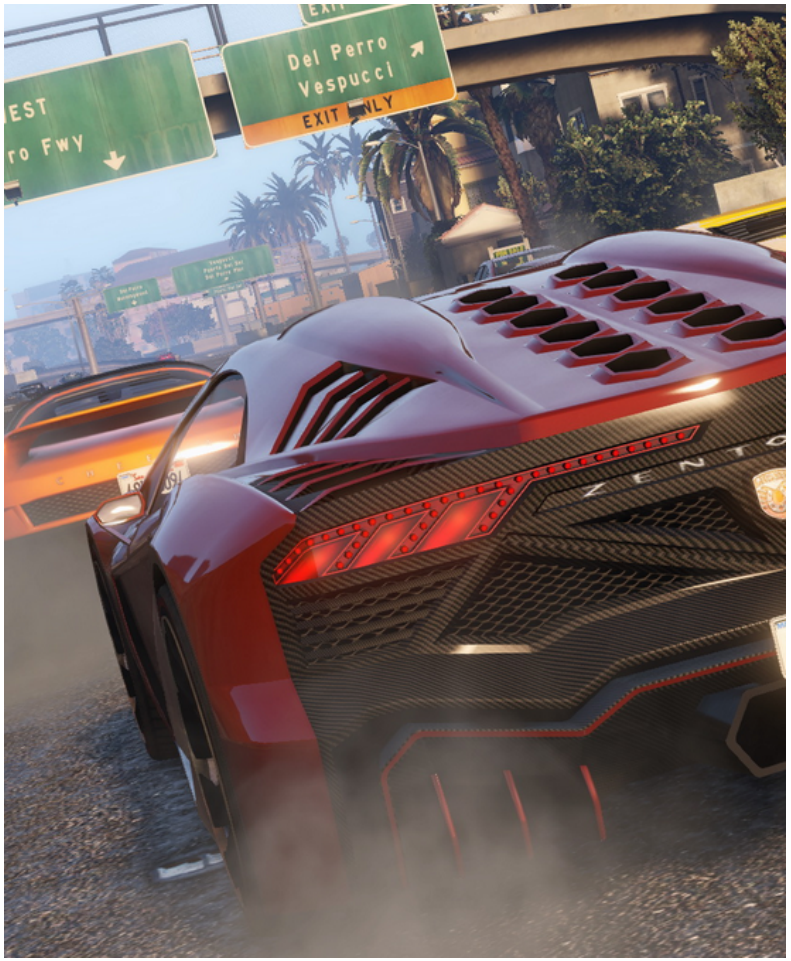
The GWAP approach (at least in the case of JeuxDeMots) is VERY effective

(Mathieu Lafourcade, personal communication)

A *fun*damental problem

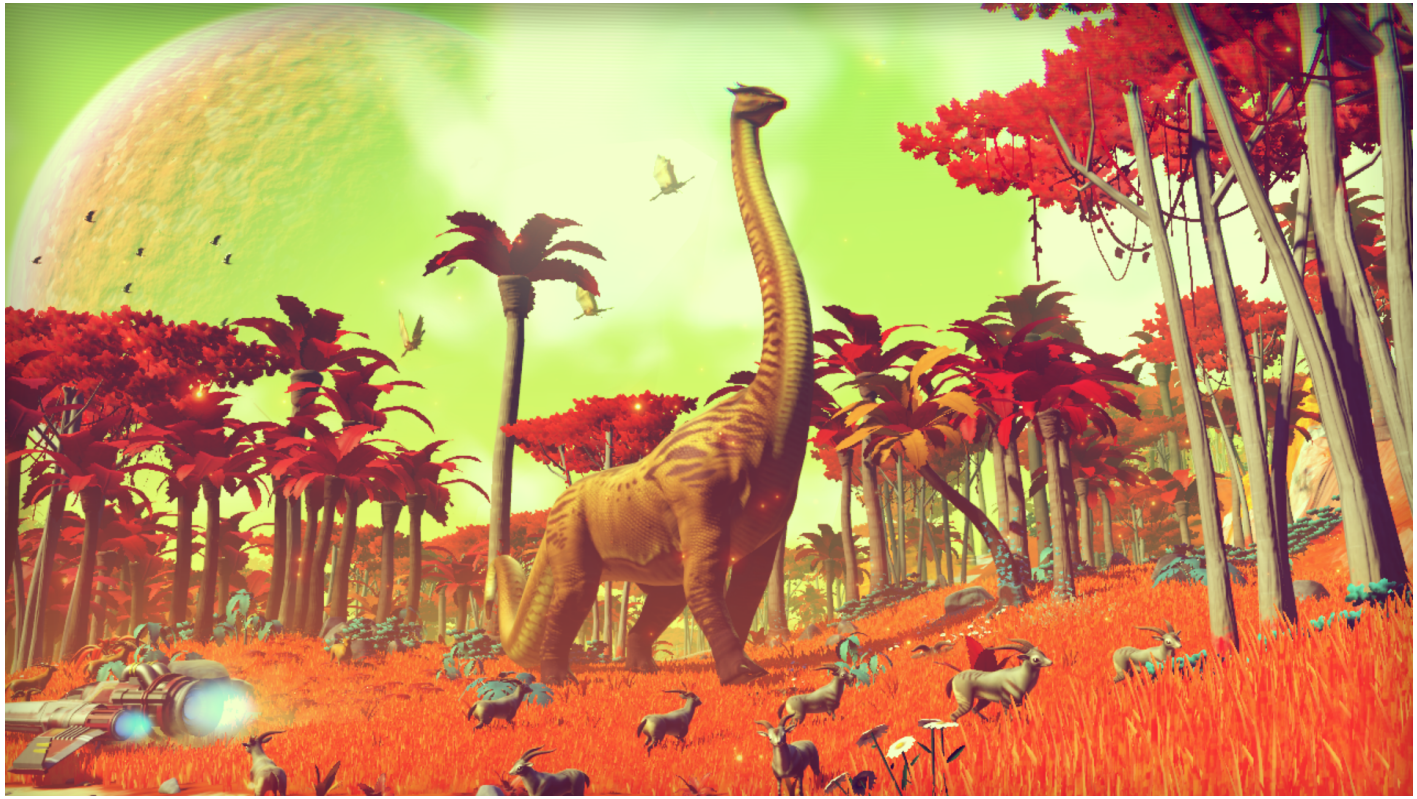
Annotation is not fun.





Vision

- seamlessly integrate annotation tasks in a modern, popular game
- exceptionally interesting: *No Man's Sky*



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