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# Formalism for a language agnostic language learning game and productive grid generation

## Design, Rules & Evolution

# Game design strategy in just 1 slide...

- “The onion” equivalent 😊
- « Chocolate coated broccoli »  
(Söbke, Bröker & Kornadt, 2013; Bruckman, 1999;  
Galarneau, 2005)
  - Agility
  - Based on generic language resources
  - Reuse successful game structures from COTS (Söbke, Bröker & Kornadt, 2013) to foster “playful attitude” (Silva, 2008).

**G | Le Gorafi** « Apprendre en s'amusant » ne serait pas amusant pour 80% des enfants interrogés

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● 89 Société Publié le 23/05/2014 par La Rédaction



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Partager

Tweeter

Coup dur pour le monde des jeux éducatifs. Les résultats d'une étude du NEC (National Entertainment Center) viennent de tomber, et ils sont édifiants. En effet, sur les 1058 enfants interrogés, 850 ne se sont pas déclarés divertis par les produits qu'ils ont essayés pour les besoins du test, et une seule conclusion s'impose alors, selon Gordon Stason, l'expert chargé de l'étude : « Apprendre en s'amusant n'est pas amusant du tout ».

# MagicWord

- Inspired by the metaludic rules (Silva, 1999) of *Boggle*, *Ruzzle* and the likes...



- 4×4 grid
  - Inflected forms
  - Contiguous letters (any direction)
  - Each cell used only once (per word)
  - Success in the game depends on
    - Lexical knowledge
    - Morphological rules of the language
    - Ability to find words in the grid

(Loiseau et al. 2016; 2018)

## MAGIC Word

find as many words

316 Words to find

R <sub>1</sub>	W <sub>4</sub>	A <sub>1</sub>	I <sub>1</sub>
H <sub>4</sub>	S <sub>1</sub>	E <sub>1</sub>	N <sub>1</sub>
T <sub>1</sub>	E <sub>1</sub>	I <sub>1</sub>	F <sub>4</sub>
U <sub>1</sub>	R <sub>1</sub>	A <sub>1</sub>	R <sub>1</sub>

0:39 202 points  
10 word

Words found	
RIF	32
FAIR	32
RAI	13
RAF	13
RARE	29
RARES	29
WEN	16
SEW	16
SAW	16
HET	16
SHE	16
RF	16
FINE	32
FIN	16
RIES	16



148 students

## RUSH MODE

> As many words as you can

Build your combos by finding many forms of the same word as you can and score bonus points



## CONQUER MODE

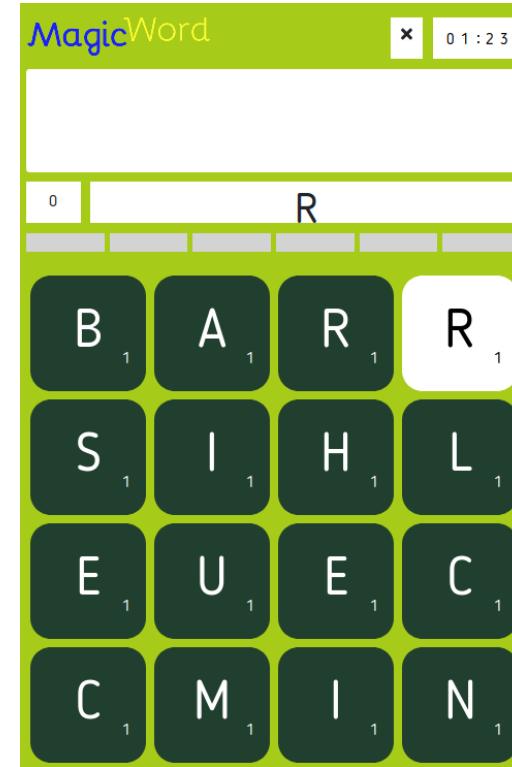
> Be the fastest to reach the objectives

### 3 objective types

- Charge combos
- Find words based on morphological constraints



- Make it available for more languages
  - Contacts in English, Italian, Spanish, German
  - Compare
    - Class integration
    - Learner acceptance
    - Outcomes
- Lack of quality resources (and expertise to assess said resources)
- Inadequate lexicon structure
- Existence of grids with very few forms (and unused letters)



# Lexicon Structure and Grid Generation Strategy



- TSV file → 3 columns
  - **Word** string to found in the grid
  - **Root** : word property (lemma, semantic field, POS, etc.), used to connect words (combo trigger)
  - N pair(s) of **features** : name and value (N=V)

have	have	number=singular, pos=noun
fun	fun	number=singular, pos=noun
playing	play	tense=gerondif, pos=verb
magic	magic	number=singular, pos=noun
word	word	number=singular, pos=noun

# Specification file

- Defines:
  - rewriting rules
    - to get rid of special characters,
    - and group certain characters to facilitate productive grids generation
  - Points
    - Letter
    - Form length
    - Combo power
    - could be automatically computed according to the lexicon (letters frequency, average word length, form/root ratio)

```

LANGUAGE=french
RELATIONTYPE=root/lemma
DESCRIPTION=Lexique Morphalou3
RW:é,è,ê,ë,E,É=e
RW:à,â,ä,á,A,ã,Å,å=a
RW:û,ü,ù,U=u
RW:ô,ö,ó,O,õ=o
RW:ï,î,í,I=i
RW:-,',@,&,.,°,º,.,µ,\,/,:,`+,~,;,^,"=
RW:ñ,N=n
RW:œ=oe
RW:æ=ae
COMBOPPOINTS:2=5,3=10,4=15,5=20,6=25,7=30
LENGTH:2=1,3=2,4=3,5=4,6=5,7=6,8=7,9=8,10=9

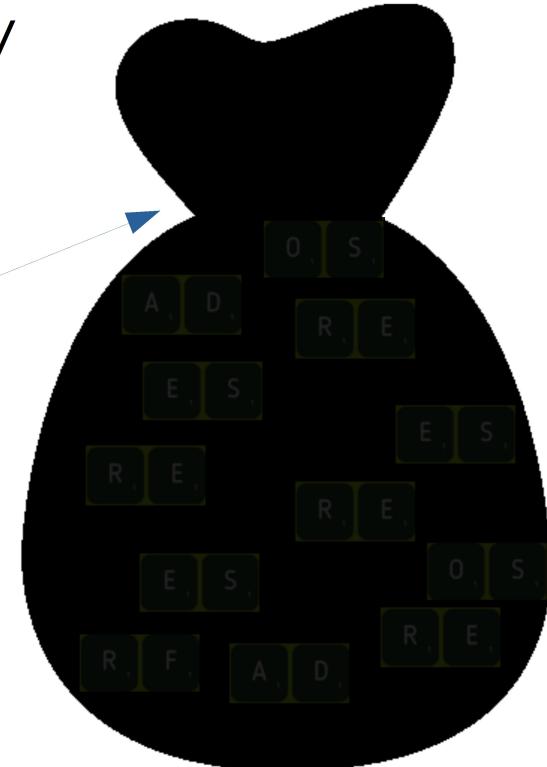
```

# Grid Generation

## Creating the bag of bigrams

- Bigrams (anagrams) sorted by frequency
- Lottery “bag” composed according to
  - Centile threshold default at 60
  - Most frequent bigrams more likely to be chosen

Bigram	Centiles
re	100
es	99
...	...
rf	60
threshold	
...	...
gh	58
nf	50
bq	1

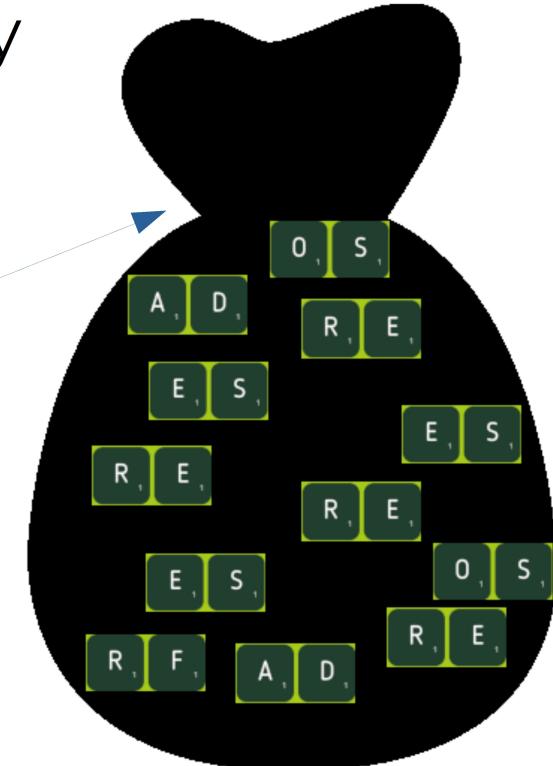


Grid Generation  
Creating the bag of bigrams

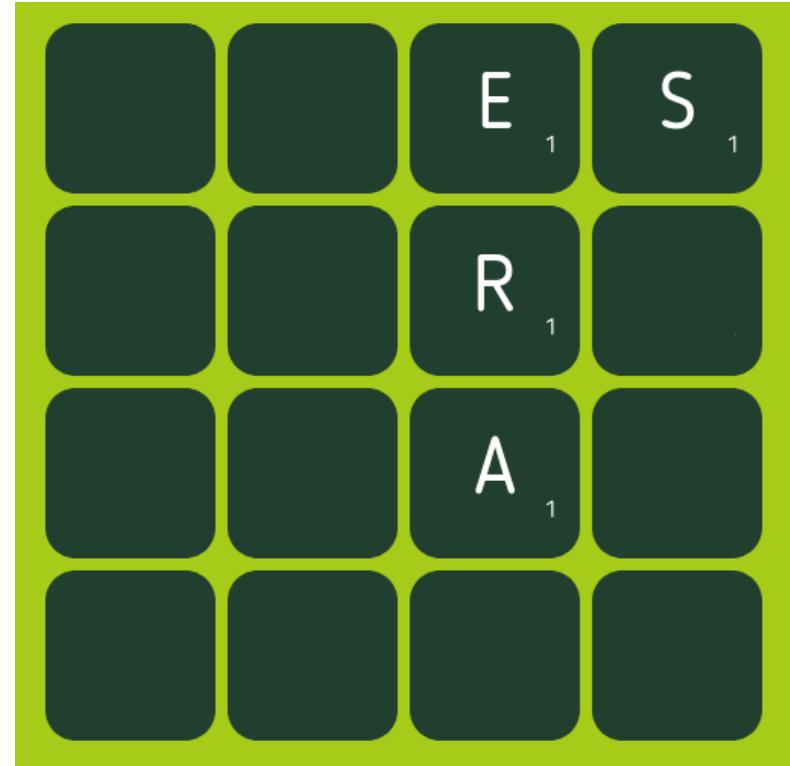
- Bigrams (anagrams) sorted by frequency
- Lottery “bag” composed

- Centile threshold  
default at 60
- Most frequent  
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Bigram	Centiles
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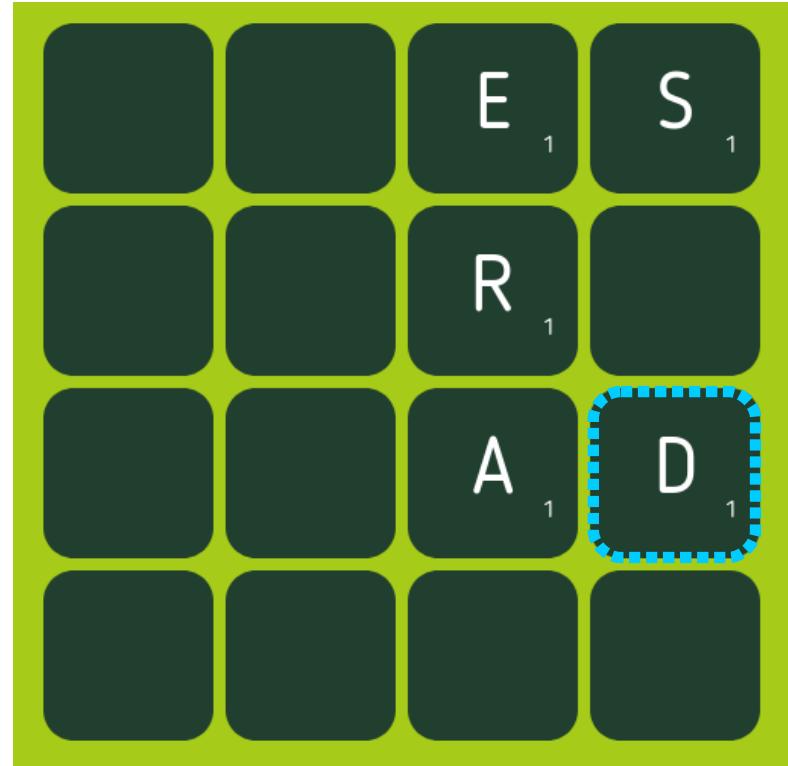


- Random bigram placing into the grid
- Frequent bigrams are most likely to be chosen in the ‘bigrams-bag’



e.g. bigram 'AD' is drawn

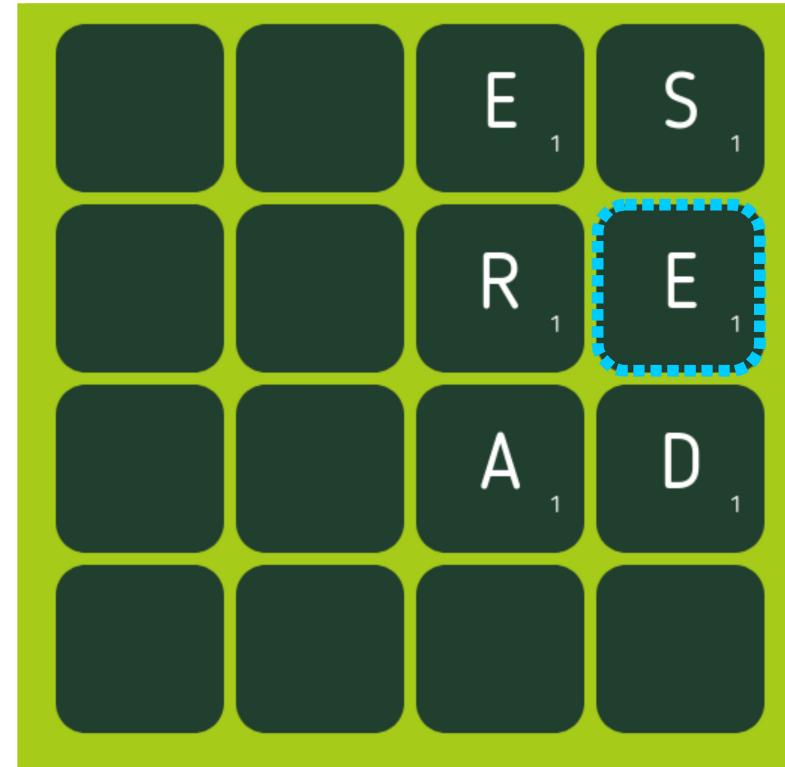
- One of its letter, 'A', already in the grid
- Only 'D' is added (connected to 'A')

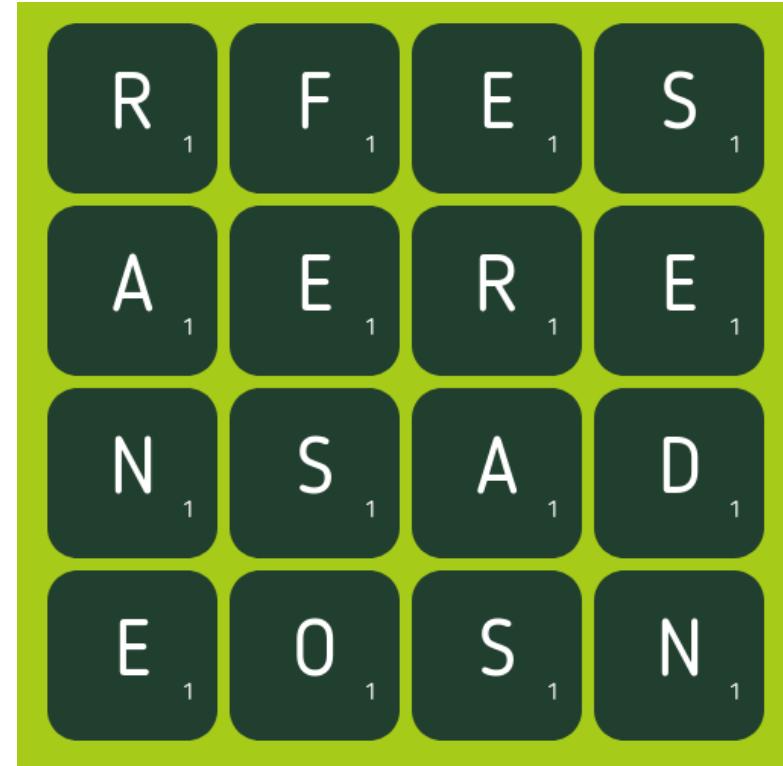


# Grid Generation

## Handling “orphan cells”

- A cell with no empty adjacent cell can't be filled with just a random bigram draw
- The lexicon letter which creates the most bigrams with adjacent letters is chosen
- The letter ‘E’ is chosen because of frequent bigrams like ‘ER’, ‘ES’, ‘EE’, ‘EA’ & ‘ED’





# Grid generation

262 PRESENT FORMS

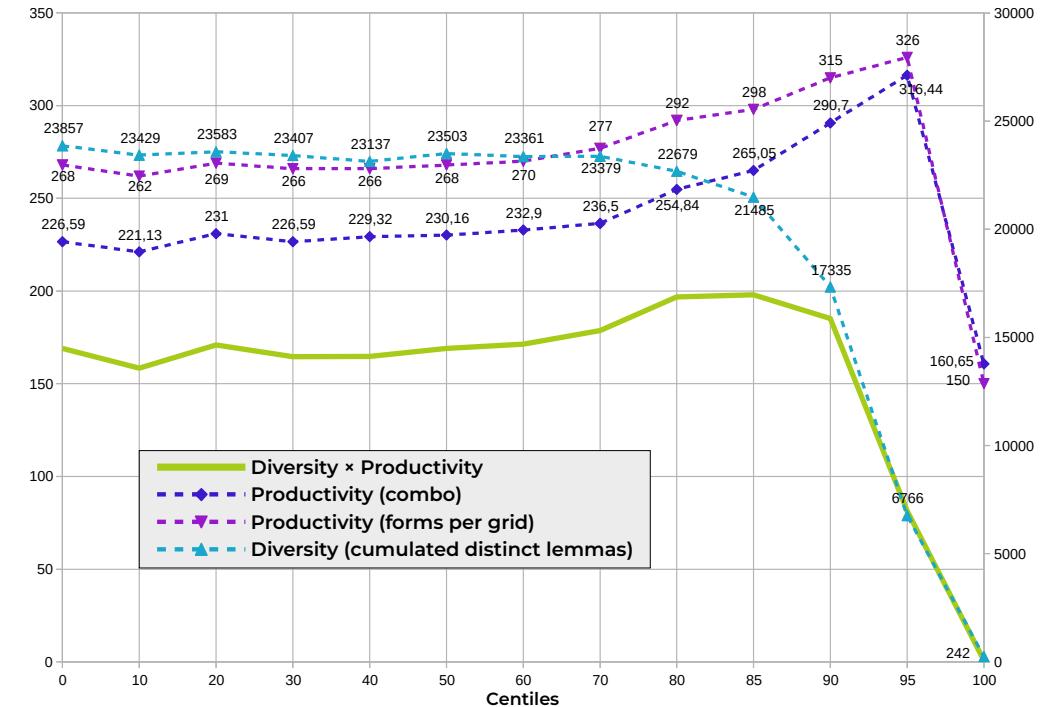
SEASONERS (17)	0%
RESEASONS (17)	0%
SEASONER (15)	0%
RESEASON (15)	0%
RESEDAS (13)	0%
SEASONS (13)	0%
SNARERS (13)	0%
SNEERED (13)	0%
REASONS (13)	0%
SEERESS (13)	0%
READERS (13)	0%
SERENES (13)	0%
SARSEN (11)	0%
RANEES (11)	0%
RASERS (11)	0%
SNARED (11)	0%
SEARED (11)	0%
EASERS (11)	0%

# As a conclusion

## Results & Further work

# Results (for French)

- Most forms are part of combos
- Diversity takes a deep dive after 80%
  - French 81%  
(Diversity×Productivity peak)





# Consequences

- Any written language
- “Root” can concern any association
  - e.g. NBA players w/ combos when naming 2 players who played together
  - Two versions of the same language can coexist, but
    - Lexicon must be large
    - Association must be Frequent
  - Author tool to get more control over content

- Add more dictionaries
- Allow root+features
- Allow user to provide their own crawler/definition
- Associate features with “translatable” interface item
- Automatically compute points
  - Take use into account (corpus/corpus for learners)
- **Test it in context**
  - Requires training of teachers
    - Game integration ~~trivial~~

**magicword.lezinter.net**

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**Data Institute**  
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