When Nobody Wins

Gorman & Yang (2017)

Tolerance Principle (Yang, 2016)

Suppose a rule *R* is applicable to *N* items in a learner's vocabulary, of which *e* are exceptions that do not follow *R*. The necessary and sufficient condition for the productivity of *R* is

$$e \leq \theta_N \text{ where } \theta_N := \frac{N}{\ln N}$$

Tolerance Principle ct'd

N	θ_N	%
10	4	40.0
20	7	35.0
50	13	26.0
100	22	22.0
200	38	19.0
500	80	16.0
1,000	145	14.5
5,000	587	11.7

Tolerance Principle - successes

- Applied successfully to nearly 100 cases (Yang, 2016)
- Artificial language studies (Schuler et al. 2016)

Tolerance Principle - assumptions

- Importantly, it is *categorical* rather than *gradient* (differing from recent work on productivity eg Baayen, 2009 and subsequent research)
- (Suggestion that it is on some level innate?)

TP applied: English past tense

- An underspecified inductive procedure identifies –d as the “regular” suffix applying to forms regardless of phonological shape – the exceptions are just a small percentage of the lexicon.
- Bring ~ brought; catch ~ caught: only 7 items in the whole lexicon – rule must be lexicalised.
- Corollary: all past-tense formation strategies different from “add –d” must be lexicalised.

TP Applied: English Past Tense

There is an almost total absence of over-irregularisation errors in acquisition (Xu and Pinker 1995; Yang, 2016)

Predicts that “add –d” will take a long time to acquire.

- CHILDES – 76/200 most common verbs are irregular, many exceptions.
- Adam (Brown, 1973) makes first overregularisation error at 2;11 (N = 300, e = 57; $\theta_{300} = 53$). Explains U-pattern in acquisition.

TP and minority patterns: German Plurals

Under all (*most) accounts, -s is fully productive (Auto ~ Autos) – there is disagreement about the others.

suffix	types	percentage
-ø	87	18.9%
-e	156	34.1%
-er	30	6.5%
-(e)n	172	37.5%
-s	13	2.8%

No suffix wins out over all others: the system is subdivided between them along suitable dimensions (for G, phonology of the last syllable & gender) since smaller N can tolerate more exceptions.

TP and gaps

Let there be S rules, each affecting N_i lexical items ($1 \leq i \leq S$), and $N = \sum_i N_i$. Gaps arise if and only:

$$\forall i \; . \; \sum_{j \neq i} N_j > \theta_N$$

When no single generalisation is sufficiently dominant, nobody wins. Gaps are ALWAYS the result of competition.

Case Studies

Spanish Verb Stems

- General case in inflection: no stem change, but there is a stress shift between the stem and the formative.
- A non-negligible number of stems does have vowel alternations in the last syllable (diphthongisation or dissimilarion) Unpredictable: *negar~niego*, *pegar~pego*; *pedir~pido*, *vivir~vivo*

Spanish Verb Stems

- Defectives are (almost) all mid-vowel stems in –*ir*, and gaps are present in the cells that feature stem changes:
- *Agredir ~ *agredo, *agriedo, *agrido*
- Defectiveness here results from speaker uncertainty.

sumergir 'to submerge' (no change):

pres. indic.	sumerjo	sumerges	sumerge	sumergimos	sumergís	sumergen
pres. subj.	sumerja	sumerjas	sumerja	sumerjamos	sumerjáis	sumerjan

discernir 'to distinguish' (diphthongizing):

pres. indic.	discierno	disciernes	discierne	discernimos	discernís	disciernen
pres. subj.	discierna	disciernas	discierna	discernamos	discernáis	disciernan

desvestir 'to undress' (lowering):

pres. indic.	desvisto	desvistes	desviste	desvestimos	desvestís	desvisten
pres. subj.	desvista	desvistas	desvista	desvistamos	desvistáis	desvistan

agredir 'to attack' (defective):

pres. indic.	*	*	*	agredimos	agredís	*
pres. subj.	*	*	*	*	*	*

TP - predictions

1st & 2nd – "no change" is dominant, exceptions are under tolerance threshold (181, 32).

3rd – lowering slightly more frequent, but too many exceptions (threshold: 10)

1st (*-a-*):		
	no change	1,200
	diphthongizing	105
2nd (*-e-*):		
	no change	144
	diphthongizing	23
3rd (*-i-*):		
	no change	3
	diphthongizing	13
	lowering	20

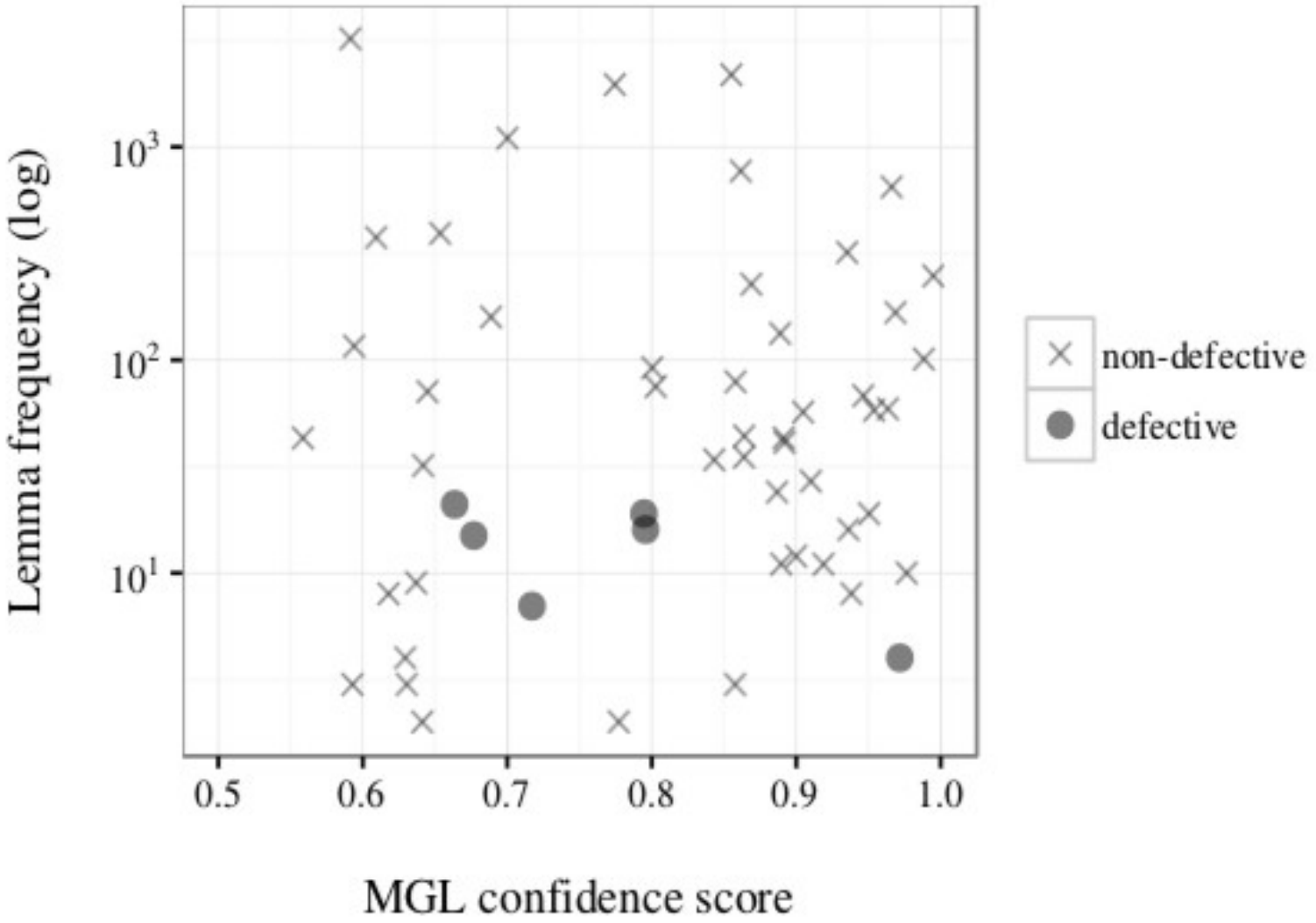
Acquisition data: Clahsen et al. (2002), Mayol (2007) diphthongisation always underapplied, almost never overapplied. –*ir* verbs only had two errors.

Uncertainty = Defectives?

- Albright's MGL (2001) - probabilistic rule induction to model Spanish verb stem changes. Accurately predicts human performance on Spanish *wug* tests.
- Each rule has confidence score, a function of pattern members and exceptions (like TP)

MGL re-applied

- MGL trained by G&Y on 3rd conj. non-defectives in mid-vowel stems.
- Each input pair is inf – ir ~ 1.SG.IND – o.
- Confidence score associated is that of highest scoring applicable rule (following Albright, 2003)


Lemma frequency (log)
10^3
10^2
10^1
0.5
0.6
0.7
0.8
0.9
1.0
MGL confidence score
non-defective
defective

Lessons from Spanish Gaps

- TP correctly predicts where defectives will be found
- Gaps are not merely a function of uncertainty
- TP mechanics may correlate with uncertainty but are not a proxy for it

Polish Masculine Genitives

- **M.GEN.SG**: either *–a* or *–u*, but **neither is the default**, and the choice appears **mostly arbitrary**. Occasionally the output is ineffable. **Suggests no productive generalisation**
- **M.GEN.PL: clear dominance** of *-ów*, a minority in *–i/y*. **Overregularisation errors** are reported in acquisition.

Polish Masculine Genitives

suffix	*n*	avg. freq.	child error rate
gen.sg.:			
-a	837	7.2	1.28%
-u	516	8.8	0.24%
gen.pl.:			
-ów	551	6.5	0.41%
-i/-y	61	11.4	15.53%

Dąbrowska (2001)'s subjects had an average of 1353 stems in the singular (threshold: 188). Both sing. patters are too numerous, predicted to be unproductive. For the plural, θ612 ≈ 95, so –òw is seleted as default.

Russian Verb Stems

- 70 defectives, all dental stems of the 2nd conjugation (*-i-*). 1st sing of non-past is gapped.
- 2nd conj verbs in *–t* have **two possible mutations** in the 1.SG.N-PST
  - affricate to č [tʃʲ] (e.g., metit’-meču ‘mark’ – **majority pattern**)
  - alveopalatal fricative šč [ɕː] (sokratit’-sokrašču ‘reduce in number’)

Russian Verb Stems

- Pertsova (2016) notes that **gaps are not always a case of competition**: there are gaps in *–d*, *-s* & *-z* stems, which are thought to only have **one possible alternation**
  - *d* and *z* to *ž* [ʒ] (e.g., *sidet'-sižu* 'sit', *vonzit'-vonžu* 'pierce, stab')
  - *s* to *š* [ʂ] (*kosit'-košu* 'scythe').
- G&Y **suggest residual competition** between Common Slavic and OCS mutations/new forms (which had the 1.SG.N-PST as one of the cells of tension)

Russian Verb Stems

- Proposal: OCS *žd* is still a competitor in 1.SG.N-PST, so there is competition in *–d* stems like in *–t* stems.
- Evidence: Sims (2006) cloze reading task to produce 1.SG.N-PST for defectives. Several participants use the OCS variant (e.g., *ubedit'*-**ubeždu* 'convince'). Mutation also found in borrowings into 2° conj.

Russian Verb Stems (?)

(10) $\left\{\begin{matrix} t \\ d \end{matrix}\right\} \longrightarrow \left\{\begin{matrix} ɕ \\ ʑ \end{matrix}\right\} / \_\_ [+1, -\text{Pl}, -\text{Past}]$ (Condition: $\sqrt{\text{sokrat-}}, \sqrt{\text{sid-}}, \ldots$)

(11) $\left\{\begin{matrix} t \\ d \end{matrix}\right\} \longrightarrow \left\{\begin{matrix} tʃʲ \\ ʒd \end{matrix}\right\} / \_\_ [+1, -\text{Pl}, -\text{Past}]$ (Condition: $\sqrt{\text{met-}}, \sqrt{\text{lit-}}, \ldots$)

(s)tʲ			
	⟶	ɕː	39
	⟶	tʃʲ	58
dʲ			
	⟶	ʑ	75
	⟶	ʒd	0

Russian Verb Stems

- What about –*s* and –*z* stems? No reported or OCS competitor. G&Y: a competitor is arising.
- English borrowings have been nativised as *s/z* stems in the 2nd conj *(fiksit' 'fix', kapsit' 'use capital letters', brauzit' 'browse, rejzit' 'raise')*
- The expected mutation is rarely applied (*kapšu)*, and no mutation is preferred (*kapsju)*
- No counts available, but conventional mutations are rare, would not take many competitor counts to satisfy condition on lexical gaps.

Conclusions

- Lack of productive generalisation is one of many factors that can lead to gaps (and the only one they lay claims towards)
- TP is a consequence of a “theoretically and empirically motivated” processing model, but not necessarily how productivity is encoded in the grammar
- Learning under TP is conservative (yet this is not the case everywhere in the grammar – why is morphology special?)
- TP proposed as an implementation of the Chomskian third factor.

Thoughts

- To what extent should they claim psychological reality for the TP?
- What determines gaps vs subdivision of the lexicon?
- What of their view of productivity?
- Stretching the data?
- Assumes optimality in language – why do things change?