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Grammar and Aggression in Human Cognitive Evolution



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*Words – so innocent and powerless as they are,
as standing in a dictionary,
how potent for good and evil they become,
in the hands of one
who knows how to combine them
N. Hawthorne*

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Highlights of today's talk

- To investigate the role of **(verbal) aggression** in human evolution, focusing on highly expressive pejorative compounds (and ideophones)
- To explain why such expressions are **good approximations/proxies of the earliest forms of language** (**reconstructed proto-grammar stage**)
 - To consider how these and other proxies are processed by the brain (fMRI experiments)
- To pursue a **gradualist scenario** for the evolution of syntax/grammar, subject to selection, contra saltationist views
- To consider how and why **physical (reactive) aggression has gradually decreased in human evolution**, correlated with the emergence of early language (cross-fertilization with Human Self-Domestication Hypothesis)
 - To seek **a common evolutionary cause** for why altered aggression, altered cross-modality (relevant for metaphoricity), and altered syntax cluster together in **cognitive disorders** affecting language
- To highlight how and why **linguistic detail and specific linguistic proxies** are essential for advancing **testable and cross-fertilizable proposals** regarding linguistic and cognitive evolution

Gradualist vs. saltationist views

- Darwin's (1874, 595) view was that language evolved gradually through sexual selection, as an instinct to acquire a particular method of **verbal display similar to music**.
 - “The sensations and ideas thus excited in us by **music**, or expressed by the **cadences of oratory**, appear, from their **vagueness, yet depth**, like mental reversions to the **emotions and thought of a long-past age**.”
- **Considering expressive language allows us to see linguistic (and cognitive) evolution as competitive, and not solely cooperative.**
- Some commonly quoted examples of expressive language:
 - gradational (reduplicative) compositions (aka **ideophones**):
wishy-washy, willy-nilly, dilly-dally, teeny-weeny, nitty-gritty, zig-zag
 - emotionally charged words: **pejoratives/swearing**
- In contrast, based on their view of syntax/grammar as an undecomposable/unnegotiable block, Chomsky (2005) and Berwick and Chomsky (2011, 2016) proposed that language/syntax emerged suddenly and recently, in its full complexity: **saltationist view**.
 - For them, syntax/language evolved as a result of one single random mutation; and it evolved for the purposes of thinking, rather than communicating.



Proto-syntax and insult

- I have considered in detail a gradualist evolutionary scenario for grammar, which includes:
 - **creating vivid innovative insults** with the crudest of proto-grammars, and the most basic of vocabulary (Progovac & Locke 2009; Progovac 2015; 2016),
 - where verbal aggression is identified as one kind of utility of the simplest grammar (there are many other beneficial uses)
- But first, **why insult?**
- And second, how can we know/hypothesize **what simplest proto-grammars were** like?
- The answers to these questions turn out to be related,
 - as the best proto-grammar approximations in present-day languages happen to specialize for insult
- Progovac, L., & Locke, J.L. (2009). The urge to merge: Ritual insult and the evolution of syntax. *Biolinguistics* 3.2-3: 337-354.

Precision comes from relying on syntactic theory and on linguistic detail

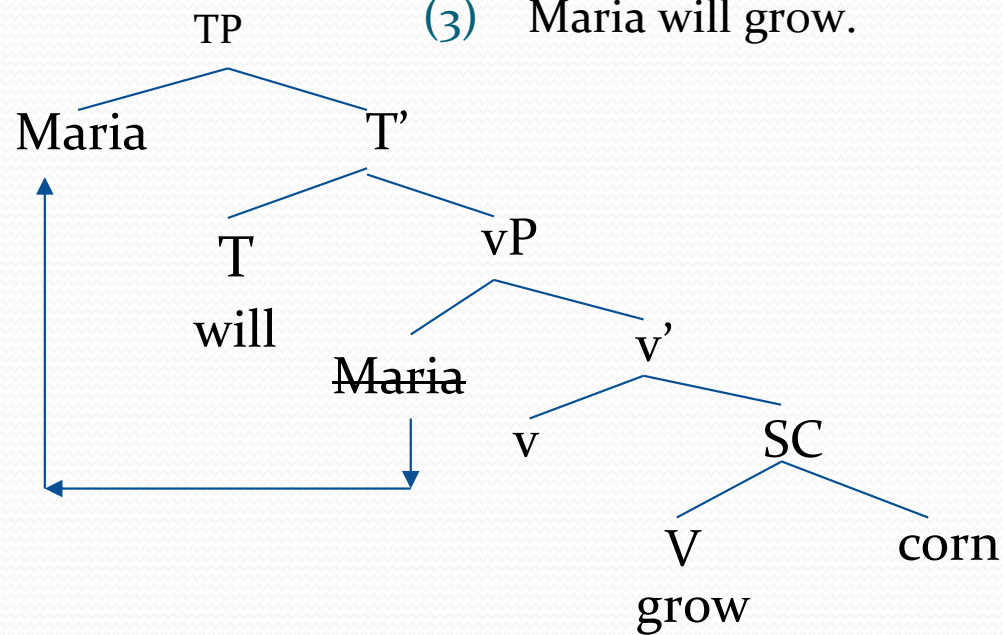
- Avoiding impressionistic proposals
- According to the syntactic theory of Minimalism and predecessors (e.g. Chomsky 1995; Adger 2003), a modern clause/sentence is characterized by the following *partial hierarchy of sentential layers*:
 - (i) **CP > TP > vP > VP/SC**
 - The inner VP/SC (verb phrase/**small clause**) layer accommodates the verb/predicate and **one argument** (noun)
 - The little verb phrase vP layer supports transitivity by accommodating **an additional argument**, such as agent
 - TP (Tense Phrase, or Sentence) accommodates the expression of e.g. tense and finiteness
 - CP (Complementizer Phrase) accommodates e.g. embedding and question formation.

Hierarchical sentence is built on the foundation of a (flat) Small Clause (SC).

The inner small clause (SC) still “lives” in **both transitive and intransitive sentences.**

- (1) Maria will grow corn.
- (2) Corn will grow.
- (3) Maria will grow.

Maria will bathe the baby.
The baby will bathe.
Maria will bathe.



A precise reconstruction of proto-syntax

- **Internal reconstruction** of the initial syntactic stage(s) (Progovac 2015):
 - (i) **Structure X is considered to be (evolutionarily) primary relative to Structure Y if X can be composed independently of Y, but Y can only be built upon the foundation of X.**
 - While SCs/VPs can be composed without a TP and little vP (transitivity) layers, the vP and TP can only be built upon the foundation of a SC/VP.
- **One can thus reconstruct a vP-less and TP-less (intransitive and tenseless) Small Clause stage in the evolution of language.**
- **Best approximations of this grammar, or “living fossils” in the sense of Jackendoff (1999), are verb-noun compounds:**
 - rattle-snake; dare-devil; kill-joy; **turn-table; turn-coat; tumble-weed; tumble-dung**
- **No possibility for subject/object distinction in this stage (novel insight, as other approaches, even gradualist (Jackendoff's), assume that there always was a subject-object distinction.**
- **Just one verb and one noun, whether subject-like or object-like**
 - Jackendoff, R. (1999). Possible stages in the evolution of the language capacity. *Trends in Cognitive Sciences* 3: 272–279.
 - Progovac, L. (2015). *Evolutionary Syntax*. Oxford University Press.
 - Progovac, L. (2016). A gradualist scenario for language evolution: Precise linguistic reconstruction of early human (and Neandertal) grammars. *Frontiers in Psychology* 7:1714. doi: 10.3389/fpsyg.2016.01714.

Verb-noun compounds specialize for insult: “unquotable coarseness”

- kill-joy, turn-skin (cf. turn-coat), hunch-back, wag-tail, tattle-tale, scatter-brain, cut-throat, mar-wood (bad carpenter), heck-wood, busy-body, cry-baby, break-back, catch-fly (plant), cut-finger (plant), fill-belly (glutton), lick-spit, pinch-back (miser), shuffle-wing (bird), skin-flint (miser), spit-fire, swish-tail (bird), tangle-foot (whiskey), tumble-dung (insect), crake-bone (crack-bone), shave-tail (shove-tail), wipe-tail, wrynge-tail, fuck-ass, fuck-head, shit-ass, shit-head.
- These compounds tend to have **transient lives**, with many of them now lost or obsolete, and with different generations being familiar with different ones;
 - there were thousands of them created in medieval times;
 - they do not get preserved in dictionaries or grammar books because they often show “**unquotable coarseness**” (Weekley 1916)

Weekley, E. (1916). *Surnames*. New York: E.P. Dutton and Co.

VN compounds in Serbian – not so lame either

- ispi-čutura (drink.up-flask—drunkard), guli-koža (peel-skin—who rips you off), cepi-dlaka (split-hair—who splits hairs), muti-voda (muddy-water—trouble-maker); vrti-guz (spin-butt—fidget); tuži-baba (whine-old.woman; tattletale); pali-drvcce (ignite-stick, matches), jedi-vek [eat-life = one who constantly annoys], kosi-noga [skew-leg = person who limps], mami-para [lure-money = what lures you to spend money]; pali-kuća [burn-house = one who burns houses]; podvi-rep [fold-tail = someone who is crestfallen]; priši-petlja [sow-loop = who clings onto another]; probi-svet [break-world = wanderer]; raspi-kuća (waste-house = who spends away property), vuci-batina [pull-whip = good-for-nothing]; kaži-prst (say-finger = index finger)
- jebi-vetar (fuck-wind—charlatan); češi-guz ‘scratch-butt;’ deri-muda ‘rip-balls’ (place name, a steep hill); gladi-kur ‘stroke-dick’ (womanizer); kapi-kur ‘drip-dick’ (name of a slow water spring); liz-guz ‘lick-butt;’ nabi-guz ‘shove-butt;’ piš-kur ‘piss-dick;’ plači-guz ‘cry-butt;’ poj-kurić ‘sing-dick’ (womanizer); seri-vuk ‘shit-wolf’
- Most are taken from Mihajlović, V. (1992). *Ime po zapovesti (Name by Command)*. Beograd: Nolit.
 - Of note is also the imperative-like form of the verb in Serbian

Transitivity evolves in diverging directions, but with a common SC denominator (minimal tweaks/tinkering with structure)

- There is **significant variation across languages** as to how they build their transitive structures, distinguishing subjects from objects;
- With rare exceptions, transitive structures across languages typically add only one extra piece to the foundational intransitive structure,
 - whether it is on top (**ergative**) or on the bottom (**accusative**), and **serial verb** patterns tend to string together a limited number of (small) clauses, often just two.
 - (i) VN (**proto-grammar** – intransitive absolutive foundation)*
 - (ii) VN_N (**accusative grammar**: adding just one additional argument (e.g. patient/theme) to (i) from below)
 - (iii) ^NVN (**ergative grammar**: adding just one additional argument (e.g. agent) to (i) from above)
 - (iv) VN VN (**serial verb grammar**: duplicating the small clause)

[*Word order VN or NV not of relevance here.]

Engaging the hominin timeline

- This led me to propose that these **widely diverging hierarchical solutions** were a later add-on, superimposed upon the common proto-syntactic foundation, and that the hierarchical layers of language **did not emerge only once and uniformly** (in Africa) in our species,
 - but instead multiple times, and independently, either within Africa, or after the dispersion from Africa (Progovac, 2015, 2016).
- At least under the uniregional view of human origins, this would suggest that **hierarchical syntax emerged no earlier than 100–50 kya**, with humans.
- On the other hand, **the proto-grammar stage could have been present much earlier**, with other species as well.
 - It has been proposed that some forms of language with grammar may have been in place as early as 500 kya, based on the skeletal and genetic evidence among *Homo heidelbergensis*' descendants, including Neanderthals and Denisovans (e.g., Dediu and Levinson, 2013; see also Johansson, 2005; Zilhão, 2011).

The Growth of Grammar

The reconstructed **proto-grammar provides the foundation** for building hierarchical syntax. It also provides **a common denominator for cross-linguistic variation.**

1. **one-word stage** (no syntax); includes also non-combinable “proto-words”: *Psst, Tsk-tsk, Ouch, Ugh, Grr* (see e.g. Jackendoff 1999, 2002)
2. the **earliest (two-slot, small clause, intransitive) syntactic stage** (reconstructed based on syntactic theory)
3. **hierarchical, transitive syntax** (subjects vs. objects differentiation, tense, embedding, etc.)

Gradual emergence of hierarchical layers

- Proposal: complex hierarchical syntax **emerges gradually** (e.g. Progovac 2015), building on the flat SCs foundation, **with each layer adding another grammaticalized, explicit expression of some category**, including:

Child development: Parallel development of language and cognition

- Parallel to the arguments for the evolution of grammar, the development of sentential structure in children between the ages of 2-5 also seems to proceed in these rough stages:
 - (i) **Intransitive SC** stage
 - (ii) **Transitivity** (vP), featuring both subjects and objects; adding explicitness to the expression of “who does what (to whom);”
 - (ii) **Tense and finiteness** (TP), featuring explicit ways of signaling tense and/or aspect, as well as subjecthood (through e.g. agreement or case);
 - Also: (iii) **Embedding and question formation** (CP), featuring explicit ways of embedding one sentence (point of view) within another, including recursively.
- This provides **a representational tool for stage-like cognitive advancements of early childhood** (Rakhlin and Progovac 2020).
- Adding increasingly complex syntactic layers to a child’s grammar, layer by layer, **expands children’s cognitive capacity** by giving them more precise and efficient ways to represent (and discover) complex information than is possible relying on non-verbal means.
 - Rakhlin, N. and L. Progovac. (2020) “Hierarchical clause structure as a tool for cognitive advances in early childhood.” *Language Sciences*. 83: 101316. doi.org/10.1016/j.langsci.2020.101316. Pages 1-19.

Grammar as “cognitive technology”

- Humans, as non-human species, are equipped with **innate basic knowledge** in a number of domains, which allows infants to make sense of objects and agents, and their relations in space and social sphere, long before they acquire language (Spelke & Kinzler, 2007).
- However, these **areas of core knowledge are limited**.
- Our proposal is that layers of syntactic structure represent “**cognitive technology**” that **supplements and augments the non-linguistic representations**.
- (Adult) humans are also quite capable of **reasoning about abstract or psychologically distant (i.e., beyond one’s direct sensory access) concepts and events**, such as:
 - hidden causes (transitivity, vP)
 - distant past and future (TP)
 - counterfactual situations (TP and CP)
 - other people’s beliefs and desires (Theory of Mind) (CP)
- While reasoning about such constructs may be somewhat possible **without language/grammar, it is at best inefficient (slow, imprecise, and inconsistent)**.
- Various experiments show correlations between syntactic and cognitive development along these lines; these claims are testable and falsifiable.

The (rough) stages of linguistic/ cognitive evolution (Benítez-Burraco and Progovac, 2020)

- **1. The first stage**, occurring roughly in the period prior to 200 kya: self-domestication (SD) processes only start to emerge, with reactive physical aggression still high; possible emergence and use of simple, proto-language forms.
- **2. The second stage**, roughly from 200 to 50 kya: an **accelerated feedback loop** between SD and the solidification of the early forms of language/grammar, both promoting a reduction in reactive physical aggression (all relying on the evolution of the same brain circuits).
- **3. The third stage**, 50–10 kya (the Upper Paleolithic): SD reaches its peak, with more cooperation and socialization and less reactive aggression; a suitable niche for language and cognition to complexify.
- **4. The fourth stage**, especially 10kya onward, after the onset of Neolithic, the rise of **proactive aggression, especially warfare** (Wrangham et al., 2006), correlated with the complexification of language and syntax, including the emergence of higher, more abstract layers of syntactic structure.
 - At this stage, hostile intergroup encounters in the form of raids and ambushes (as also observed in present-day hunter-gatherer societies, Allen and Jones, 2014), were being replaced by **escalated, coordinated battles** (Kissel and Kim, 2019)

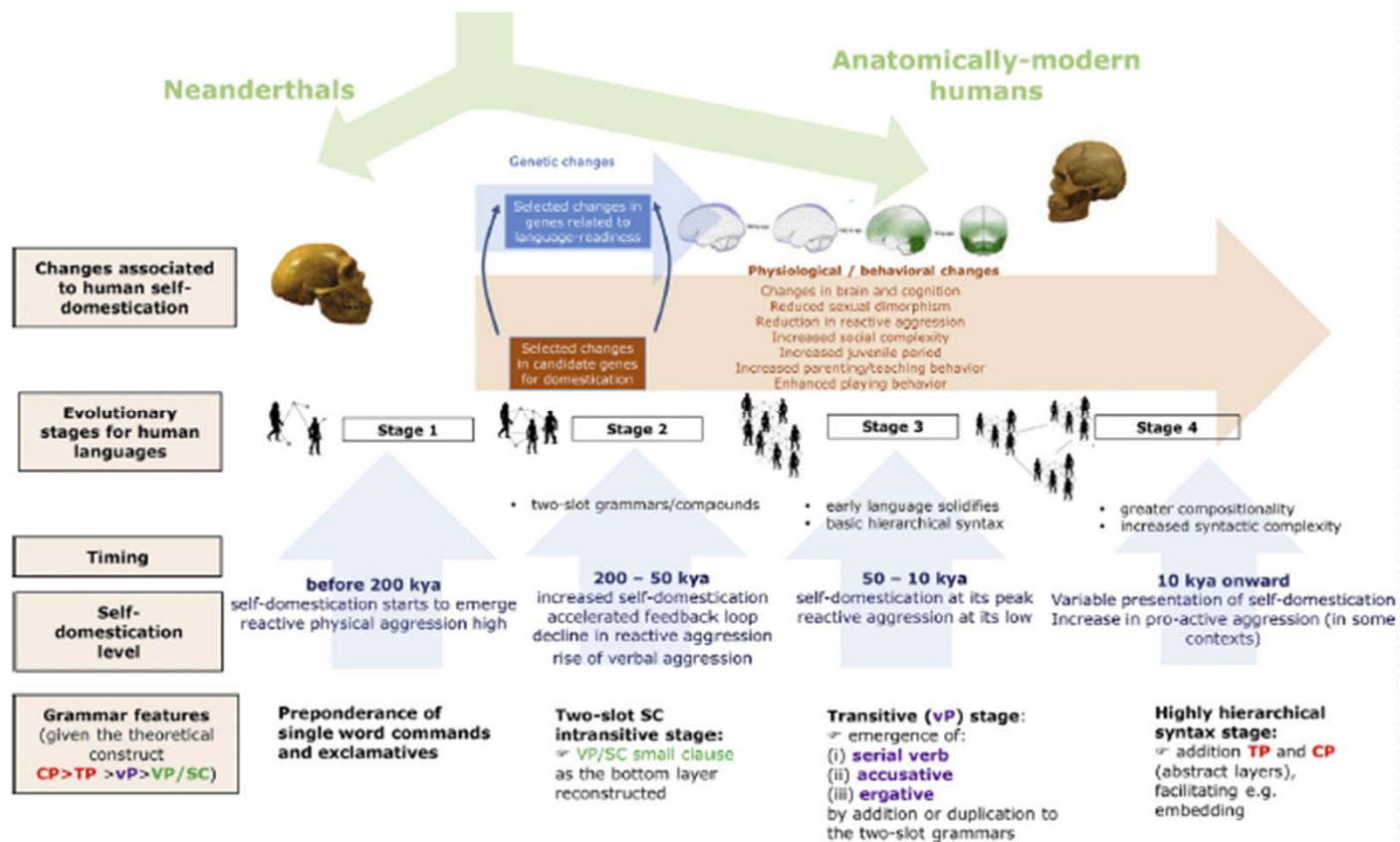


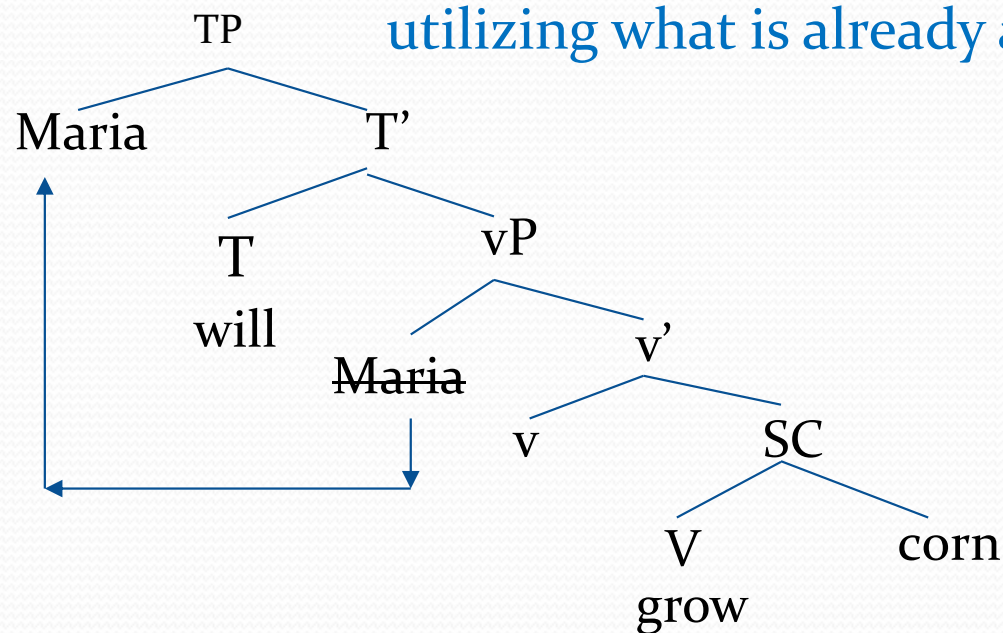
Fig. 1. A graphical summary of the four-stage model of language evolution in our species under the effect of self-domestication.

Continuity of (proto-)grammar on both ends: with modern grammars, and with other species

- Looking forward, the structure of these proto-grammars (e.g. compounds) **foreshadows/ predetermines the very nature of modern human grammars**, in three crucial respects:
 - their binary combinatorial nature
 - their small clause intransitive inner layer
 - their reliance on nouns and verbs to express who does what (to whom), i.e. basic predication

Recall that hierarchical sentences are built on the foundation of a (flat) Small Clause (SC).

Modern syntax posits binary branching only; only two units can be merged at a time, forcing hierarchy, and utilizing what is already available: the two-slot SC.



Continuity with other species

- On the other end, looking backward, **comparatively speaking**, other primates seem capable of simple **two-slot combinations** (with no subject/object differentiation):
 - such as *hide peanut* and *hide Kanzi* (see e.g. Greenfield & Savage-Rumbaugh (1990: 161) regarding **bonobo Kanzi**);
 - according to Patterson & Gordon (1993), **gorilla Koko** is not only capable of producing novel two-word metaphorical combinations (e.g. **'tookie rock'**, for a stale bun), but also of insult, playfulness, and humor.
 - Darwin (1872) observed that **strong emotions** expressed in animals are those of lust and hostility, and that they may have been **the first verbal threats and intimidations uttered by humans** (see also Code 2005)
- If so, then **proto-syntactic two-slot compositions, expressing verbal aggression**, would have provided **a more graceful transition** from animal communication to human language, **both in terms of combinatorial abilities, and in terms of emotional load**.
 - Darwin, Charles (1872). *The Expression of the Emotions in Man and Animals*. London: John Murray.

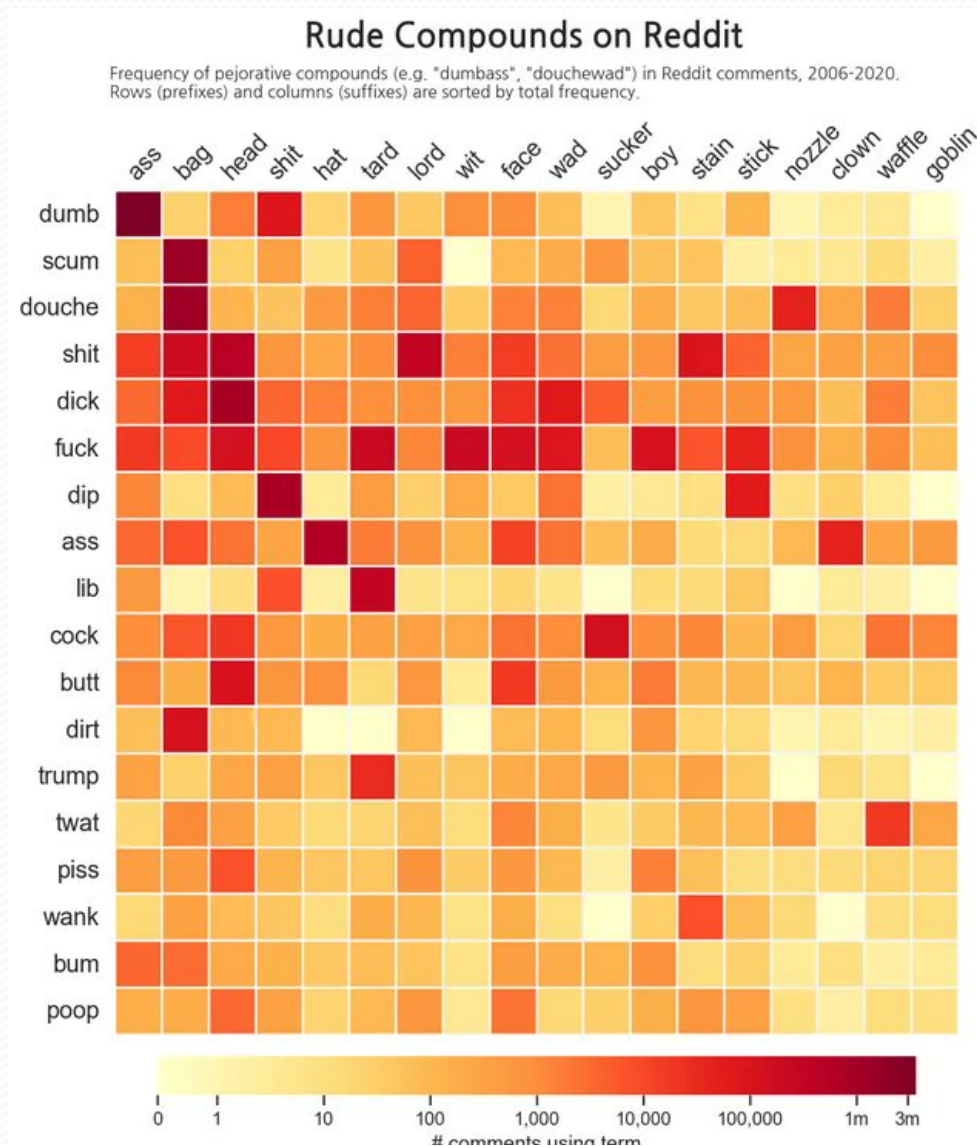
So, why insult? Adaptiveness of verbal aggression

- First, I was taken to this evolutionary scenario **by simply following the syntactic reconstruction I performed, and the data it led me to** (i.e. hundreds of verb-noun compounds across languages, which turn out to **specialize for insult** when referring to humans).
- Also, considering **insult (i.e. verbal aggression) reveals direct and immediate selection/survival benefits.**
 - Bergen (2016: 7): the most potent words of all are **swear words and expletives**, especially those that are highly **taboo**, which “elicit **the strongest measurable psychological reactions: the fastest pulse, the sweatiest palms, the shallowest breathing.**”
- **Insult (verbal aggression) is also neurobiologically “real”/tangible, leading to testable hypotheses.**
- It also leads to **cross-fertilization with Human Self-Domestication** hypothesis, whose main ingredient is also aggression, i.e. physical reactive aggression.
- Even though my focus here is on verbal aggression and insult, **the benefits and uses of this kind of proto-grammar would have been much broader**, including: **naming animals** (*tumble-dung; swish-tail (bird); stink-bug*), **plants** (*tumble-weed; catch-fly*), **objects, and places**; expressing **basic commands** (e.g. *Catch fly! Turn snake!*) and **basic statements** (e.g. *Bug stink; Monkey see*).

Cognitive, at the expense of physical contest

- The emergence of proto-grammars affords a new, **more adaptive way to compete for status and sex** in ancient times
- Power to create **many novel expressions**, never heard before, and **to capture a trait of a person, and to discredit a person, with only two basic proto-words**
- **Words can hit just as hard as stones, but only in the hands of the one who knows how to combine them** (cognitive evolution)
- Their successful use would have **enhanced relative status**
 - first by derogating existing rivals and placing prospective rivals on notice (aggressive rivalry),
 - and second by demonstrating verbal skill and quick-wittedness (mate choice) (Progovac and Locke, 2009)
 - **both types are relevant for sexual selection** (Darwin 1874)
- **Dramatic increase** in the variety and expressivity of insults relying on **proto-grammar compounds, vs. just isolated words**

Compounding the insult: The power of two-slot combinatorial syntax (over just single words)



The poetic dimension of verb-noun compounds

- Weekley (1916): this is a very **expressive** way of naming
- Mihajlović (1992), who devoted his career to collecting over 500 Serbian place and people names (VN compounds), calls them **condensed compositions which** pack in them ... frozen fairy tales, proverbs, and ancient wisdoms and metaphors (1992: 8-9)
- For Darmesteter (1934: 443), the artistic beauty and richness of these compounds (in French) is **inexhaustible**:
 - “At the time of Renaissance, Ronsard introduced [VN compounds] in a new and original manner as epithets: *Jupiter lance-tonnerre, le soleil donne-vie, Hercule porte-massue...*
 - It would be well could French poets again make use in **lofty poetry** of this class of epithets; for they may attain **Homeric breadth...**”

The audacity and the poetry of insult

- Samarin (1969) collected 3,000 **ideophones** in Gbeya (Central African Republic), many of which are humorous insults; **reduplicative and poetic**

nũ-mě́ ɔ̄ vɔ̄bi vɔ̄bi,
nũ-bárá-ri-gedá gá wèn.
*Your mouth is soggy.
Like soaked manioc.*

- Acc. to Samarin: people who are more prone to use insults than others might **set a model** for the other villagers by their “**skill, imagination, and audacity**” (sexual selection argument)
- One can say that someone is short or tall, using regular adjectives, without getting very much reaction, but the ideophones invariably arouse laughter.
- the initiation of humor itself is considered to involve **strong assertiveness** (i.e. **audacity**, in Samarin’s sense) (see e.g. McGhee 1976)

What are ideophones?

- The structure of ideophones is also typically a **two-slot mold**
- Prototypical examples are **reduplicative and iconic** in imitating the sounds (*tick-tock*) or the sights (*zig-zag*), **directly relevant for cross-modality** considerations (Cuskley & Kirby 2013)
- They are also **playful** and **creative**
 - (1) tick-tock; zig-zag; flip-flop; willy-nilly; wishy-washy; hanky-panky, okey-dokey, mumbo-jumbo, teeny-weeny, nitty-gritty
 - (2) tika-taka; cik-cak; **trte-mrte** (aha, you are scared!); **apa-drapa** (dressed in an unruly, disorderly manner); kuku-riku (rooster's call) (Serbian)
 - (3) mî mê (mosquitoes buzzing); plî -plǎn (empty bottle submerged in water filling up) (Hmong, Martha Ratliff, p.c.; 2010)

Some languages are especially rich in such ideophones, numbering in the thousands, including Gbeya, Japanese, Korean, Hmong

- They are often used, and effectively so, for **ridicule and insult**.
- **Ideophones are processed differently by the brain:**
 - Lockwood and Tuomainen's (2015) EEG experiment found that ideophones in Japanese elicit a specific brain response not found in non-ideophonic adverbs,
 - which is consistent with abundant linguistic literature reporting on the **vivid experience' of ideophones** (e.g. Doke, 1935, for Bantu languages).

Verb-noun compounds are also processed differently by the brain

- In an fMRI experiment we contrasted the processing of verb-noun compounds (e.g. *kill-joy*; *pick-pocket*; *cry-baby*) vs. hierarchical compounds (e.g. *joy-kill-er*; *boot-lick-er*; *whistle-blow-er*)
 - and found **a robust effect in the fusiform gyrus area (BA 37)** (Progovac *et al.* 2018b)
- BA 37 is the area where visual processing and certain non-compositional semantic processing (e.g. concreteness, metaphor) come together (e.g. Bookheimer, 2002)
- Verb-noun compounds seem to evoke a **more vivid, more visceral effect**,
 - even though the two compound types were matched in imageability/metaphoricity (see above)
 - Progovac, L., Rakhlin, N., Angell, W., Liddane, R., Tang, L., & Ofen, N. (2018b). **Neural correlates of syntax and proto-syntax**: An fMRI study. *Frontiers in Psychology* 9:2415, 1-16. doi: 10.3389/fpsyg.2018.02415

The simpler the grammar, ...

- ... the more expressive the language
- The layer(s) of abstract syntactic structure seem to render **-er compounds** in the experiment **less visceral, less expressive**,
 - meaning that **the postulated proto-grammars are a better fit for expressive language, including insult**
- If so, then it is **not a coincidence** that **derogatory language/insult has been so well preserved in these proto-grammatical compositions, across different languages**
- Verb-noun compounds are often:
 - **aggressive and humorous** (audacity), both of which are relevant for self-domestication hypothesis, and for sexual selection argument,
 - they are also highly **metaphorical** (relevant for cross-modality, and for the poetical dimension).
 - Aggression and poetry can go together?

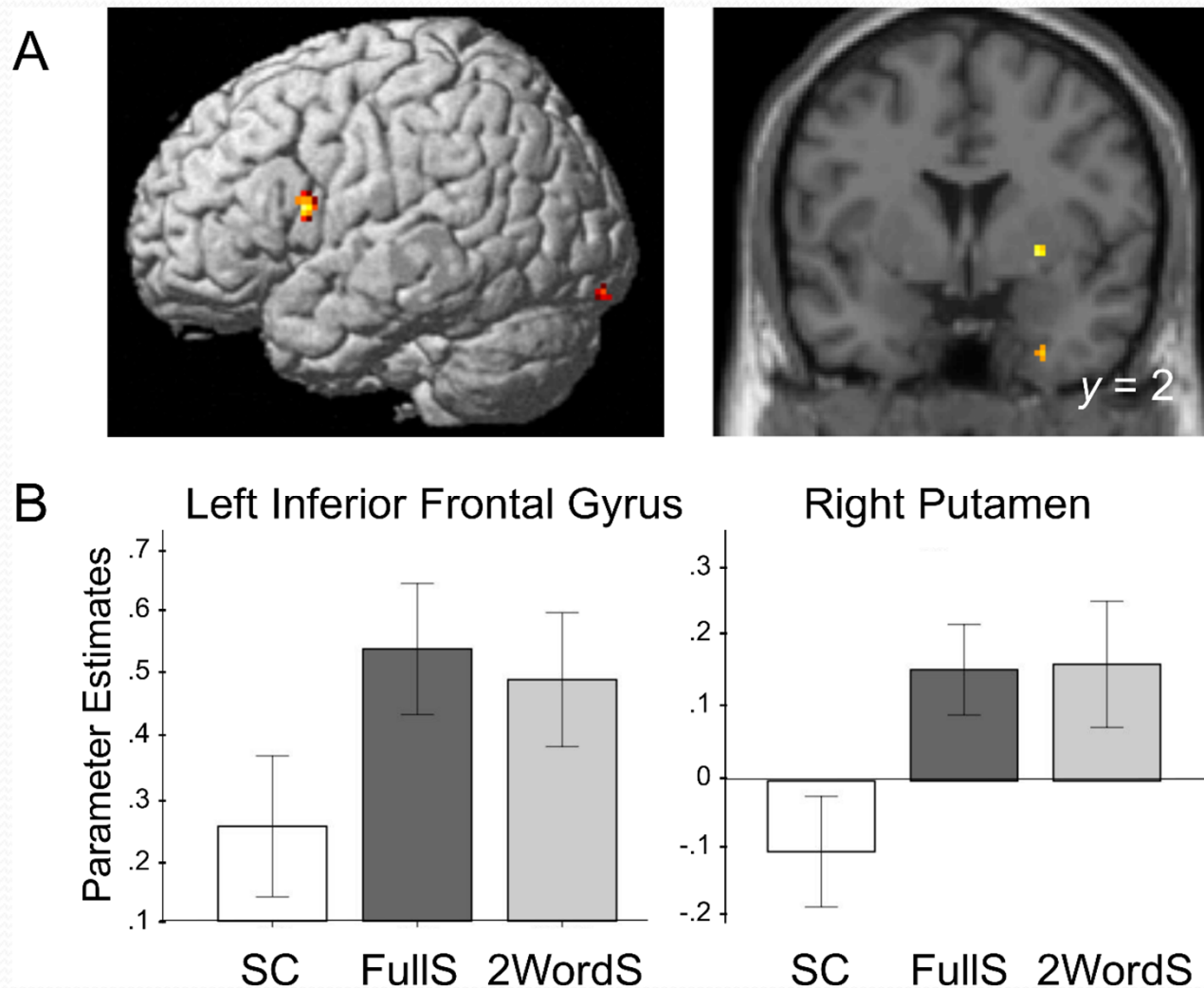
What is cross-modality?

- Cross-modality is crucial for the processing of **metaphorical/figurative extensions**, upon which language in general heavily relies, including grammar;
 - it often involves **interactions among multiple sensory modalities**,
 - (cf. e.g. metaphors such as *bitter cold*; *loud shirt*; *sharp cheese*)
 - “Using figurative language allows [one] to be both **playful** and to communicate information **effectively** It provides tools to **paint a picture with words** (the words are bringing images to the reader’s mind)” (Merriam-Webster Dictionary)
- According to Ramachandran and Hubbard (2001), **the beginning of cross-modality** possibly involved a cross-wiring in **fusiform gyrus**
- The fusiform gyrus area (specifically **BA 37**) is also implicated in **synesthesia**, a condition of **enhanced cross-modality** (due to atypically exuberant brain connectivity),
 - where simulation of one sensory or cognitive pathway leads to involuntary experiences in another (e.g. Cytowic & Eagleman 2009; Cuskey & Kirby 2013)

Root small clauses (mini sentences) are also processed differently by the brain

- In an fMRI study, full sentences with Tense (TPs) (*The case is closed; The apology is accepted*) were contrasted with TP-less small clauses (*Case closed; Apology accepted*), another proto-grammatical structure.
- There was **reduced activation in (TP-less) Small Clause condition** compared to both full TP sentences and the control conditions,
 - **both in the Broca's area (left BA 44) and the right basal ganglia** (Progovac *et al.* 2018b)
 - affirming the relevance of Broca's–basal ganglia network for the processing of more articulated, more layered syntax

Full TP sentences > small clauses in English



Broca's-basal ganglia network for syntax

- **Syntactic processing relies heavily on the cortico-subcortical networks,**
 - which include the Broca's area, in particular BA 44, and basal ganglia (e.g. the striatum) (Friederici, 2017; Opitz and Friederici, 2007; Teichmann et al., 2009, 2015; Szalisznyó et al., 2017).
- Broca's area is not the sole center for **syntactic processing**, but rather part of a larger circuit that involves subcortical structures (e.g. Gibson, 1996; Lieberman, 2000, 2009; Vargha-Khadem et al., 2005; Ardila et al., 2016a,b; Ullman, 2006).
- There is evidence that **Broca's-basal ganglia network** has been **bolstered via selection in recent evolution**, in the line of descent of humans (and Neanderthals),
 - resulting in increased synaptic plasticity and neuronal connectivity,
 - with FOXP2 and other genes playing a role (see e.g. Ullman 2006; Dediu 2015; Hillert 2014)
- The emergence and gradual **complexification of syntax** would have played a critical, **active role** in this evolutionary development of the brain
 - The emergence of two-slot proto-grammars may have been **the most important milestone** in the evolution of human cognition

Language evolution is linked to management of aggression (and vice versa)

- Our proposal is that the emergence of proto-grammar, as well as the enhancement of cross-modality, are **partly a side-effect, and partly a cause**, of human **management of (reactive) aggression**, as it relates to human self-domestication (HSD).
(Progovac and Benítez-Burraco, 2019; also: Benítez-Burraco and Progovac, 2020, 2021).
- The **HSD hypothesis** is based on the existence in our species of many of the features found in domesticated animals, including:
 - prolonged juvenile period; reduced sexual dimorphism;
 - **reduced reactive aggression; reduced response (of the HPA axis) to stress** (hypothalamic–pituitary–adrenal axis); **decrease in cortisol levels** (relevance of humor) (Shea, 1989; Somel et al., 2009; Herrmann et al., 2011; Hare et al., 2012; Plavcan, 2012; Stringer, 2016; Hare, 2017; Theofanopoulou et al., 2017; Thomas and Kirby, 2018; Benítez-Burraco et al., 2020).
 - Crucial driver of HSD is considered to be **a gradual reduction in reactive aggression**,
 - **typically attributed to** (sexual) selection for less aggressive/less reactive partners, and in favor of pair-bonding (e.g. Hare et al. 2012; Stanyon and Bigoni 2014; Okanoya 2015; Gleeson 2018)
- **Later stages of human evolution**, featuring highly hierarchical, elaborate syntaxes, correlate with enhanced aggression, but this time, it is **proactive (premeditated) aggression**.

Feedback Loop: Emerging grammars and taming of aggression (HSD)

- Our proposal is that these **early stages of grammar** (as approximated by e.g. derogatory verb-noun compounds) engaged in a **mutually reinforcing gene-culture feedback loop with HSD, which was targeting physical aggression** (Progovac & Benítez-Burraco, 2019),
 - because they provided **a more adaptive way to replace reactive physical aggression with verbal aggression**,
 - thus **significantly accelerating** both the evolution of language (including metaphoricity and syntax) and the evolution of HSD, **all of which rely on enhanced connectivity of the cortico-striatal brain networks**
- This **linguistic dimension added to the HSD hypothesis** ensures that human evolution did not just yield a tame (but mute) phenotype (perhaps like bonobos),
 - but, in fact, a phenotype excelling at channeling physical aggression/reactivity into verbal behavior.

- Progovac L, Benítez-Burraco A. 2019. **From physical aggression to verbal behavior: language evolution and self-domestication feedback loop.** *Front. Psychol.* 10, 2807. (doi:10.3389/fpsyg.2019.02807)
- Benítez-Burraco, A., and L. Progovac. (2020) **A four-stage model for language evolution** under the effects of human self-domestication. *Language & Communication* 73, 1-17

Altered processing of metaphorical language

- The ability to understand and make use of figurative (metaphorical) language seems to be altered in most, if not all, cognitive conditions, including **synesthesia**, but also ASD(**autism**) and SZ (**schizophrenia**) (Benítez-Burraco 2017)
 - **ASD** individuals face difficulties establishing connections between two elements of a compound whose combination requires metaphorical “stretching” of meaning (e.g. Riches et al. 2012; Kambanaros et al. 2019)
 - tendency to default to literal interpretations
 - According to e.g. Imke et al. (2008), **neurons in fusiform gyrus** are fewer and smaller in autistic individuals.
- In contrast, various types of **hallucinations** experienced by **SZ** individuals may be attributed to an atypical disinhibition of cross-modality, akin to that found in **synesthesia**.
 - Synesthetes in fact exhibit an advantage in language abilities, related to a variety of advantages in memory (e.g. Rouw et al., 2011, van Leeuwen 2020),
 - and this also applies to relatives of SZ individuals.
 - Synesthetes also show superior understanding of unfamiliar sound symbolic foreign words, including **ideophones** (Bankieris and Simner 2015).

Poles on the continuous cline

- **ASD** is characterized by higher levels of reactive aggression (and so is Tourette's Syndrome, **TS**), in comparison to both typical and SZ populations (Hill et al. 2014; Fitzpatrick et al. 2016).
 - However, **SZ** exhibits higher levels of proactive (i.e. premeditated) aggression (Bo et al. 2013), especially in comparison to ASD.
- Deficits in language structure and use are found in **both ASD and SZ** (Bailey et al. 1996, Tager-Flusberg et al. 2005, van Os and Kapur 2009, Stephane et al. 2014).
- **ASD** individuals exhibit difficulties with metaphors and abstract concepts more generally (Dodd, 2005; Jordan, 2010); tend to be hyper-systematic and literal (also the case with **TS**)
 - People with **SZ** can also show difficulties with novel metaphors (Rapp et al., 2018), as well as humor (Pawelczyk et al., 2018).
 - Nonetheless, SZ individuals exhibiting a mild, nonclinical manifestation of psychotic-affective conditions show relative strengths, e.g. when interpreting metaphors, emotions, humor, and irony (Crespi, 2008: 238).
 - In addition, relatives of people with SZ were found to have an advantage in artistic expression and originality (Fink et al., 2014).
- Crespi B, Badcock C. (2008) **Psychosis and autism as diametrical disorders of the social brain**. *Behav Brain Sci*.

Cognitive conditions as adaptations for language

- **Certain aspects** of the conditions such as ASD (**autism**) and TS (**Tourette Syndrome**) can provide:
 - a glimpse into **the earlier stages of linguistic evolution** characterized by
 - a higher degree of reactive aggression,
 - emerging grammatical regularity, and
 - emerging cross-modality, i.e. metaphoricity
- In contrast, **synesthesia** (and to some extent SZ (**schizophrenia**)) can provide
 - a window into **a later development**, when higher levels of (disinhibited) connectivity in the cortico-subcortical and other brain networks would have resulted in:
 - exaggerated, super cross-modality, among a significant portion of the population,
 - as an adaptation to acquire language,
 - as well as to suppress reactive aggression
 - **with a side-effect of hallucinations and delusions** in SZ, but also sometimes in synesthesia
 - (based on Benítez-Burraco and Progovac, 2021)

Why do altered aggression, altered cross-modality, and altered language structure cluster together in disorders?

- Our finding implicates **the cortico-striatal brain networks**,
 - whose dense connectivity is instrumental not only for **curtailing reactive physical aggression** (by enabling cortical structures to exert better control over subcortical structures),
 - but also for metaphoricity, by **enhancing cross-modal connections**
 - and for processing **syntax**.
- This suggests that (i) **taming of aggression**, (ii) **cross-modality (metaphoricity)**, and (iii) **language structure/syntax co-evolved**, supported by enhanced connectivity in the same brain circuits.
 - Benítez-Burraco, A. and L. Progovac (2021), “Language evolution: examining the link between cross-modality and aggression through the lens of disorders.” *Philosophical Transactions of Royal Society B*.

Atypical inhibition in cortico-striatal brain circuits: ASD and TS

- On the one hand, **TS and ASD** have been found to exhibit an interneuron dysfunction that gives rise to an **altered degree of inhibition of specific cortico-striatal circuits**, resulting in reduced control of striatal activity by cortical structures (e.g. Rapanelli et al. 2017; McBride and Parker 2015)
 - contributing to **atypical degrees of reactive aggression** in both ASD and TS, as well as to involuntary verbal aggression (including coprolalia in some TS individuals)
 - The damage to these networks also leads to the specific kind of disinhibition in aphasia, i.e. the production of **speech automatisms**, including uncontrollable swearing (Code 2005; 2011; Code et al., 2009).
 - Worbe et al. (2012) relate TS characteristics to cortico-basal ganglia network immaturity, the network also implicated in physical aggression and language processing Mink 2003; Ganos et al. 2013).
 - Specifically, Lischinsky and Lin (2020) found that the suppression of aggression demands an increased control of the striatum, among other subcortical regions, by the prefrontal cortex.

Atypical disinhibition: synesthesia and SZ

- On the other hand, synesthesia and SZ involve an atypical disinhibition in these networks
 - According to Grossenbacher and Lovelace (2001), synesthesia is a result of **disinhibited cortical sensory feedback** (see also Cytowic 1993).
 - One possible explanation is to invoke a failure of adequate pruning of connections which typically takes place in ontogeny (e.g. Maurer, 1993; Baron-Cohen et al. 1993; Ramachandran and Hubbard, 2001; Mauer and Mondloch, 2006; Ward, 2013)
 - Interestingly, **ASD** has been characterized as involving over-pruning, i.e. aggressive synaptic pruning during childhood (Thomas et al., 2016)
 - Silbersweig et al. (1995) ascribe SZ hallucinations in both auditory and visual modalities to the abnormal disinhibition of cortical-subcortical circuits.
- In sum, both **enhanced cross-modality and (the suppression of) reactive aggression**, including verbal aggression, rely on **a precise degree of (dis)inhibition of connectivity in the cortico-striatal brain circuits**,
 - the same circuits that are **also essential for the processing of syntax** and language more generally.

Extensive individual variability

- Various cognitive conditions affecting language involve **patterns of inhibition vs. disinhibition** that seem to be **poles on the continuum of cognitive modes**,
 - encompassing also the typically-developing cognition.
- This highlights the **extensive individual variability across all the dimensions relevant for language**,
 - which moreover seems to be **genetically influenced**.
- Such individual variability has been (and will be) providing **a fertile ground for natural/sexual selection** to operate
 - both in the past, and in the future.
- These considerations suggest that the evolution of human language/syntax cannot be seen as a simple, straightforward, one-mutation step (e.g. Berwick and Chomsky 2016),
 - but rather as a complex, gradual, ongoing, multi-faceted and multi-gene phenomenon (e.g. Dediu 2015; Dediu and Ladd 2017),
 - with **each new development and innovation potentially subject to selection.**

Final thoughts

- Generally speaking, human evolution saw a gradual shift
 - from the more emotional (reactive) to the more rational (premeditated);
 - from primarily physical contest to primarily cognitive/verbal contest and behavior more generally.
 - But, **human aggression (or competitiveness) have not been eliminated** – they only changed shapes and forms...
- Paradoxically perhaps, according to this approach, humans became more tame and more cooperative by practicing verbal aggression,
 - i.e. by replacing physical aggression by verbal aggression;
 - early grammars already afford **effective, humorous, playful means for practicing verbal aggression**, and **deflecting physical aggression**.
- Considering **expressive language** allows us to see linguistic (and cognitive) evolution as gradual, and also as competitive, and not solely cooperative
- In all this, **the emergence of language, in particular proto-grammars, would have played a critical, active role**,
 - directly influencing the evolution of **the brain**.
 - “A great stride in **the development of intellect** will have followed, as soon as the **half-art and half-instinct** of language came into use.”
Darwin (1874).