Metaphor in academic writing in science and the humanities: Mediating between the "two cultures"

Christoph Haase
Chemnitz University of Technology

1. Introduction

“metaphor in cross-cultural communication”

“The Two Cultures” by C.P. Snow (Rede Lecture, 1959)

→ gulf between sciences and humanities due to communication breakdown
- a major obstacle to solving “the worlds’ problems”

→ thus a possible mediator between the “two cultures”
- rests upon linguistic observations about academic discourse

The “social constructionist“ view of academic discourse

“writing is always a personal and socio-cultural act of identity whereby writers both signal their membership in a range of communities, as well as express their own creative presence” (Hyland, 2006)

2. The Academic Discourse situation

author/speaker & reader/listener: contract of diffusing knowledge
A B from A to B

Contract: A and B both share the knowledge that:

A knows that B does not know everything that A knows (about X)

A uses conventionalised strategies to express him/herself comprehensibly
→ metaphor and hedging as a means to modify **propensity** of a statement

Propensity: degree of probability of a statement to hold true

→ **A relies on shared cognitive endowment with B (instruments of bodily perception)**

2.1 Diffusion of knowledge in academic texts

diffusion through metaphors:
diffusion through hedges:

1. the author A of an academic text knows that reality has more than “ideal” cases of e.g. Newtonian mechanics but is blurred at microlevels
→ hedge an utterance by saying “Ideally,…” etc.

caveat: intended listeners share this knowledge and don’t need the explicit hedge marking

2. the author B of a popular academic text (who at the same time is an informed reader of 1.) knows that his/her readers **do not** share the knowledge of 1.
→ the hedgy precision of 1.) has a different function

→ **metaphors and hedging used as simplification**

3.) the reader C of 2.) has a contract that contents will be processed and force-fed via hedges and metaphors

C knows that C does not know what A or B know so C expects lexicalization that coincides with C's knowledge by

transformation of specific knowledge (target domain) to
generic knowledge (source domains)

→ **cognitive core of metaphorization**
→ implicit similes in perception:

"look at X **like** look at a representation/reification of X"

but: researcher is not really "looking"
data is not really "there"

3. What characterizes academic texts?

0104PN Mitochondrial substitution rates are extraordinarily elevated and variable in a genus of flowering plants

Phylogenetic relationships within **Plantaginaceae** were determined from a 4,730-nt data set consisting of portions of four chloroplast regions (ndhF, rbcL, and **intergenic spacers atpB rbcL** and trnLtrnF). Relationships within Plantago subgenus Plantago were analyzed from a **9,845-nt data set** containing two additional chloroplast regions (intergenic spacers psaAtrnS and trnCtrnD). **Maximum likelihood (ML) trees** were constructed with PAUP* by using the general time-reversible model, a gamma distribution with four rate categories, and an estimate of the proportion of invariant sites. The rate matrix, base frequencies, shape of the **gamma distribution**, and proportion of invariant sites were estimated before the MLanalysis from a neighbor-joining tree constructed from the data. Divergence times outside Plantaginaceae were taken from ref. 27. Those within the family were calculated by using a penalized likelihood approach (28) as implemented in the R8S program (29) and a time constraint of 48 million years (27) for the Antirrhinum Plantago split. The ML tree was used as the starting tree for the divergence time analysis. The starting tree was constructed by first constraining the taxa in the 4,730-nt data set to incorporate the alternative relationships within subgenus Plantago and then estimating branch lengths for this topology in PAUP*. A smoothing factor of three was determined by using the R8S cross-validation procedure.

0104NS Plant DNA shows speedy changes

The mitochondria of a group of nondescript flowering plants contain the fastest-evolving DNA yet known. Until now, the mitochondrial genomes of plants were thought to evolve slowly. But when Jeffrey Palmer and colleagues at Indiana University in Bloomington compared mitochondrial DNA from nine species of plantain (members of the genus Plantago) and 41 other plants, they found that some Plantago sequences changed

3.1 Academic vs. popular-academic strategies

Academic texts use:

a) high degree of lexical specialization
b) cohesive markers based on cause-effect relationships

Popular texts use:

a) syntactic compression and semantic simplification,

cf. *Indeterminate-length quantum coding* vs. *The ultimate computer*

b) lack of lexical differentiation

c) overuse of stylistic devices like amplifiers (*completely*, *absolutely*) and boosters (*very*, *highly*, *immensely*)

→ lack of lexical differentiation mirrored by lack of scientific differentiation

3.2 Metaphors in physics and psychology

arXiv:astro-ph/0201342 v1 21 Jan 2002

Gamma Ray Bursts from the First Stars: Neutrino Signals
Raffaella Schneider, Dafne Guetta, Andrea Ferrara
If the first (PopIII) stars were very massive, their final **fate** is to collapse into very massive black holes. Once a proto-black hole has formed into the stellar core, accretion continues through a disk. It is widely accepted, although not confirmed, that magnetic fields **drive** an energetic jet which produces a burst of TeV neutrinos by photon-meson interaction, and eventually **breaks out** of the stellar **envelope** appearing as a Gamma Ray Burst (GRB). Based on recent numerical simulations and neutrino emission models, we **predict** the **expected** neutrino diffuse **flux** from these PopIII GRBs and compare it with the capabilities of present and planned detectors as AMANDA and IceCube. If **beamed** into 1% of the sky, we **find** that the rate of PopIII GRBs is = 4 × 106 yr-1. High energy neutrinos from PopIII GRBs could dominate the overall **flux** in two energy **bands** [104-105] GeV and [105 - 106] GeV of neutrino telescopes. The enhanced sensitivities of forthcoming detectors in the high-energy band (AMANDA-II, IceCube) will provide a fundamental **insight** on the characteristic explosion energies of PopIII
GRBs

Acta Psychologica
Volume 118, Issue 3 , March 2005, Pages 245-260

Save the last dance for me: unwanted serial position effects in jury evaluations
Wändi Bruine de Bruin,
Whenever competing options are considered in sequence, their evaluations may be affected by order of appearance. Such serial position effects would **threaten** the **fairness** of competitions using jury evaluations. Randomization cannot reduce potential order effects, but it does **give** candidates **an equal chance** of being assigned to preferred serial positions. Whether, or what, serial position **effects emerge** may depend on the cognitive demands of the judgment task. In end-of-sequence procedures, final scores are **not given** until all candidates have performed, possibly **burdening judges' memory**. If judges' evaluations are based on how well they remember performances, serial position effects may resemble those found with free recall. Candidates may also be evaluated **step-by-step**, immediately after each performance. This procedure should not **burden memory**, though it may produce different serial position effects. Yet, this paper reports similar serial position effects

→ both text types use metaphors to make argumentation transparent

- salience of visual metaphors in physics
- hedge marking in psychology

What are the functions of verbs of perception?

3.3 Manner classification: English as a manner language

Classic approach: Influential two-way typology by Talmy, 1985

- parameters of a motion event: FIGURE, MOTION, PATH, GROUND, MANNER, CAUSE

(1)	The boat	floated	under	the bridge
	FIGURE	MOTION+MANNER	PATH	GROUND

manner languages (English, German, Swedish, Russian)

- MANNER is typically encoded in verb, path info in nonverbal elements (PP)

path languages (Greek, Spanish, Japanese)

- verb encodes direction of MOTION, MANNER in gerunds, PPs or omitted

3.3 Manner classification: English as a manner language

Framing function of PATH parameter:

- verb-framed languages: conflate MOTION + PATH
- satellite-framed languages: conflate MOTION + MANNER

(2) a. to swim across the river
b. cruzar el río nadando

→ motion/space is an empirically rich domain (Papafragou, 2002)

although: manner languages have path verbs
path languages have manner verbs

but: the preferred lexicalization differs

3.4 Circular Motion in science texts

ac-burr - 199
If the orbit passes over the poles the Earth will spin under it every 24 h, so that any point on the surface will pass below the orbit every 12 h.

ac-burr - 470
The satellites have a cylindrical form. They are stabilised to spin about an axis parallel to the Earth's axis at a rate.

ac-burr - 211
If the orbit radius is chosen at a certain value, then the period of the orbit can be exactly 24 h which means that the Earth will rotate beneath at precisely the same angular velocity. So the satellite will remain above the same point over.

ac-davies - 294
To return the particle to its initial state it is necessary to rotate it through 720°.

tou-newc - 47
It swivels about its centre point on huge roller-bearings and is operated by hydraulic pressure. The High Level Bridge, which is further

→ Circular motion, cf. *spin/rotate/turn/twist/pivot/swivel...*

3.5 “Manners of perception”

Manner: emerges in preferred lexicalisation patterns

→ substantial manner of perception in the visual field expected

advantages:	manner typology is metaphorical expected to be different in the “two cultures”
assumptions:	Humanities are more logical because terminology-driven? Sciences are more visual because empirically driven? Can a specific metaphorical use in popular sciences be isolated?

3.6 Verbs of perception

visual		**auditory & olfactory**	**tactile/haptic**
admire	*observe*	*hear*	*feel*
discover	*peek*	*listen*	*sense*
focus	*peer*	*savor*	*touch*
gaze	*perceive*	*smell*	
glance	*recognize*	*sniff*	
glimpse	*see*	*taste*	
goggle	*spot*		
inspect	*squint*		
leer	*stare*		
look at	*watch*		
notice	*witness*		

→ all refer to default, cognitive standard situation

- all accept complements (objects, prepositional objects, clausal complements)

+HUMAN **V_{percep}** **DO**

3.7 Source and Target domains

„one of the reasons why different historical periods produce large numbers of items from similar conceptual metaphors is due to **the way we perceive our environment**. The very essence of **our forms of perception appears not only to be figurative in nature** but also inevitably so…" (Trim, 2007)

Source domain: conventional, bodily perception

Target domains: complements of $V_{percept}$ (direct objects, subjects of clausal complements)

(3) **0004AX** NNS mechanic . SENT. Here RB here we PP we focus VVP focus a DT **a pilot-wave** NN pilot-wave **analogue**

Source: put something in the focus of attention

Target: abstract representation of a measured phenomenon

4. The Corpus of Scientific and Popular Academic English (SPACE)

4.1 Compilation and structure

binary structure: 1) academic texts,
2) popular-academic texts

academic texts: from 3 preprint servers for academic publications.

Physics	*arXiv.org*
BioSciences	*Proceedings of the National Academy of Sciences*
Psychology	*Public Library of Science - Medicine* (PLoS)

popular-academic texts: *New Scientist*

4.2 Corpus content and subcorpora

subcorpus	descriptors	word count
arXiv	physics, astrophysics, computer science, quantum mechanics	161,864
New Scientist – physics	physics, astrophysics, Computer science, quantum mechanics	40,694
Proceedings of the National Academy of Science (PNAS)	biochemistry, genetics, genetical engineering, microbiology	267,105
New Scientist - biosciences	biochemistry, genetics, genetical engineering, microbiology	30,499
Public Library of Science – Medicine (PLoS),	psychology, public health	217,254
New Scientist – medicine	psychology, public health	17,050
total		**734,466**

4.3 Parallel corpus samples

subcorpus	words	title
arXiv	5.768	*Indeterminate-length quantum coding*
New Scientist	468	*The ultimate computer*
arXiv	3.852	*Quantum phase transitions and the breakdown of classical General Relativity*
New Scientist	2.134	*What lies beneath*
arXiv	2.226	*The disruption of stellar clusters containing massive Black Holes near the galactic center*
New Scientist	162	*Star shepherds*
PNAS	2.338	*Spirochete and protist symbionts of a termite (Mastotermes electrodominicus) in Miocene amber*
New Scientist	128	*Tiny fossil has guts*
PNAS	4.963	*Feeding acetyl-L-carnitine and lipoic acid to old rats significantly improves metabolic function while decreasing oxidative stress*
New Scientist	137	*Pep pills for old age*

4.4 Mean length of academic and popular articles

subcorpus	mean length in words
arXiv	3.113
New Scientist	634
PNAS	4.359
all	2.262

- text length as parameter of semantic depth
- popular texts always shorter than scientific counterparts
- their distribution is far from normal: standard deviation of 729,7

= higher than the mean

- heterogeneous profile of journalistic texts

range: short research news (minimum: 110 words) to
full-length feature articles (2.000+ words)

5. Verbs of perception in sciences and humanities

total numbers from POS-tagged corpus:

Verbs	Physics 001AX-046AX	BioSciences 047PN-106PN	NS Physics 001NS-046NS	NS BioSciences 047NS-106NS	Psychology
visual perception					
discover	20	17	7	15	12
focus	21	21	2	4	3
glance	0	0	3	0	2
inspect	0	1	0	0	7
look at	3	0	0	0	2
notice	13	4	10	3	16
observe	123	182	18	1	246
peer	0	1	1	2	2
perceive	2	25	1	1	101
recognize	4	23	0	3	8
see	305	264	74	28	219
spot	0	1	13	4	30
stare	0	0	1	0	11
watch	0	0	1	0	16
auditory perception					
hear	0	6	2	3	22
listen	0	0	1	0	51

5.1 Corpus Examples

V_{visual}	Example
discover	**0104PN** discussion We PP we have VHP have discovered VVN discover unprecedented JJ unprecedented variation NN varia
focus	**0004AX** NNS mechanic . SENT. Here RB here we PP we focus VVP focus a DT a pilot-wave NN pilot-wave analogue
inspect	**0088PN** be evaluated VVN evaluate by IN by inspecting VVG inspect probability NN probability plots NNS plot display
notice	**0028AX** We PP we notice VVP notice that IN that , , , in IN in spite NN spite of IN
observe	**0017AX** Mmin . SENT. We PP we observed VVD observe 10 CD @card@ events NNS event in IN in the DT the
peer	**0032NS** allowing VVG allow us PP us to TO to peer VV peer inside RB inside , he PP he speculates
perceive	**0027AX** low-energy probes NNS probe perceive VVP perceive as IN as Minkowski NP (flat JJ fla
recognize	**0004AX** evaporate if IN if one PP one recognises VVZ recognize that IN that our PP$ our universe NN universe is
see	**0047PN** density map NN map , , , we PP we see VVP see at IN at least JJS least four CD four to TO to fi
spot	**0008NS** should be VB be able JJ able to TO to spot VV spot the DT the NNS terminuses NNS terminuses . SENT. A D
stare	**0004NS** Right now RB now we PP we 're VBP be staring VVG stare into IN into a DT a sort NN sort of IN of quantum

5.2 Totals Visual Perception

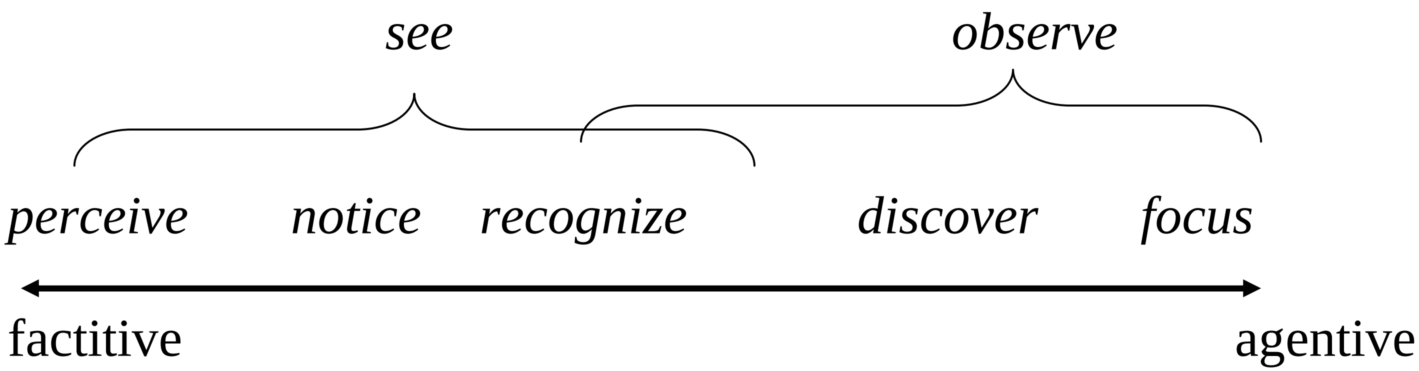
Subcorpus	words	V_{visual}	V_{visual} per 100k words
Physics	202.558	622	307,1
BioSciences	297.604	600	201,6
Psychology	217.254	676	288,5

→ physical sciences have highest relative share of $V_{percept}$

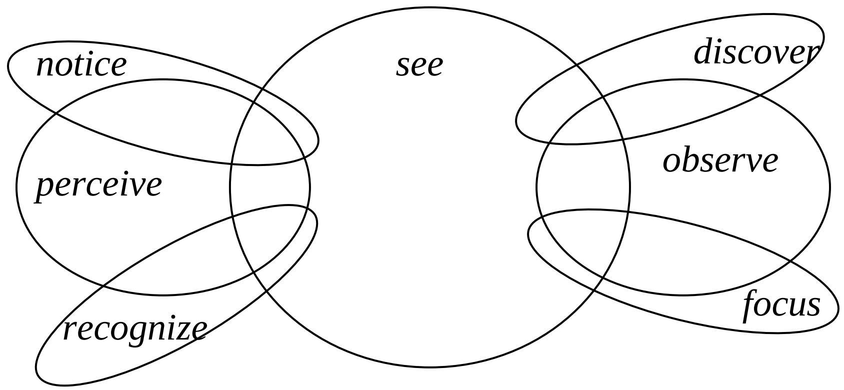
- low counts for auditory/olfactory $V_{percept}$
- low/zero counts for diversified manners of perception
- lexical variability highest for psychology
- marked difference for popular-academic physics

Subcorpus	V_{visual} per 100k words
Physics – academic texts	303,3
Physics – popular-academic texts	320,0
BioSciences – academic texts	201,8
BioSciences – popular-academic texts	200,0

5.3 Continuum of perceptual agency



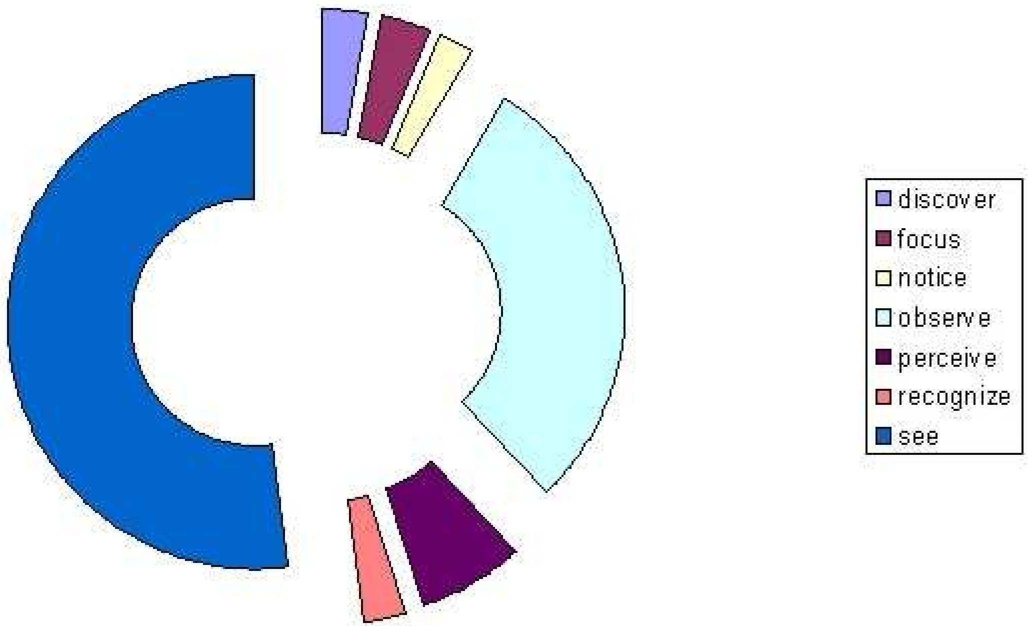
Groupings: top-down view

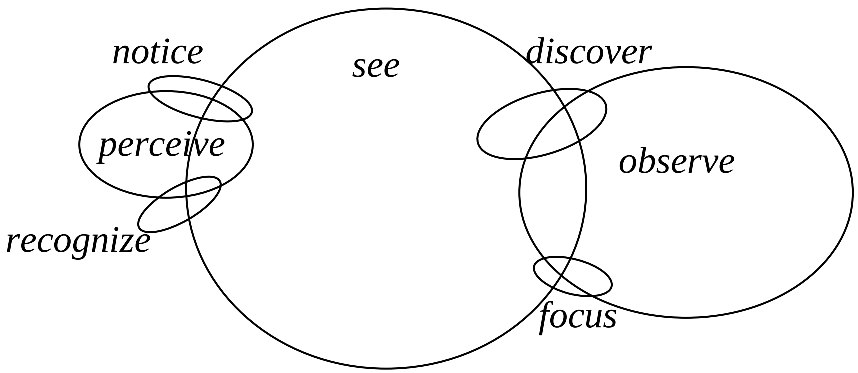


5.4 Subtotals for most frequent V_{visual}

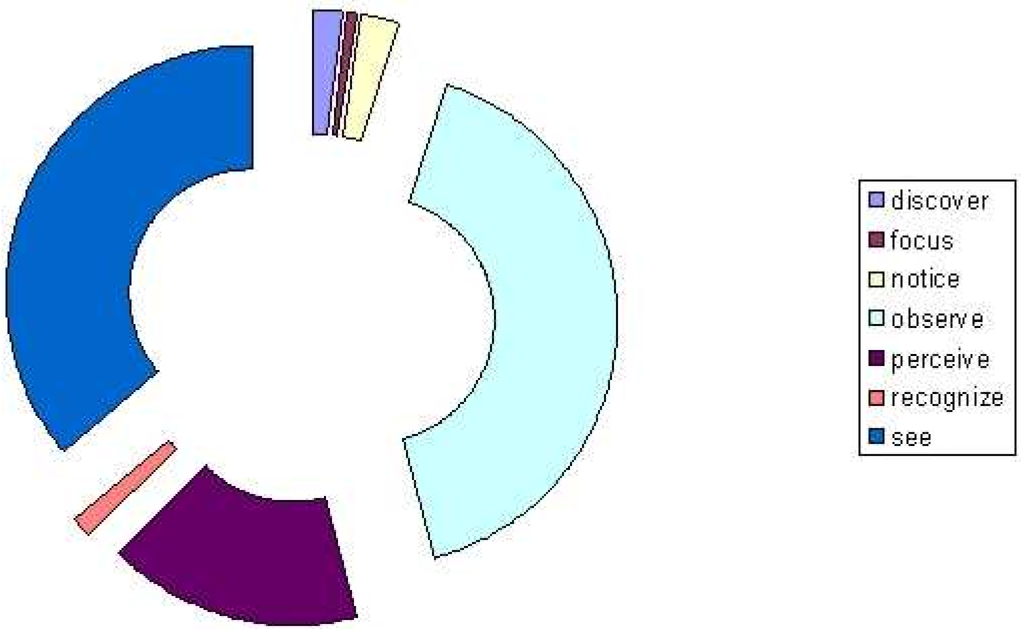
	Physics		subtotal	BioSciences		subtotal	Psychology	total
verb	**popular**	**academic**		**popular**	**academic**			
discover	7	20	27	15	17	22	12	71
focus	2	21	23	4	21	25	3	51
notice	10	13	23	3	4	7	16	46
observe	18	123	141	1	182	183	246	570
perceive	1	2	3	1	25	26	101	130
recognize	0	4	4	3	23	26	8	38
see	74	305	379	28	264	292	219	890

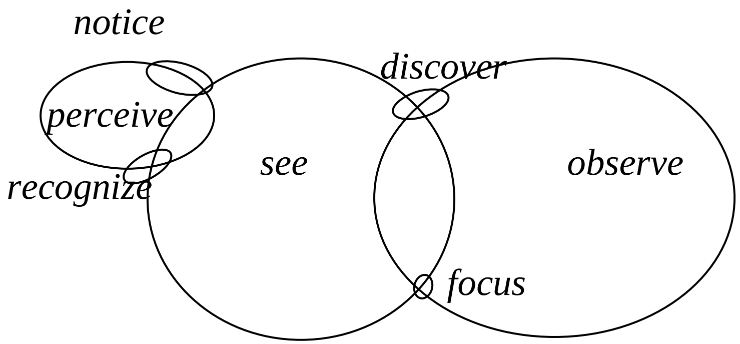
5.5 Groupings: bottom-up view; total



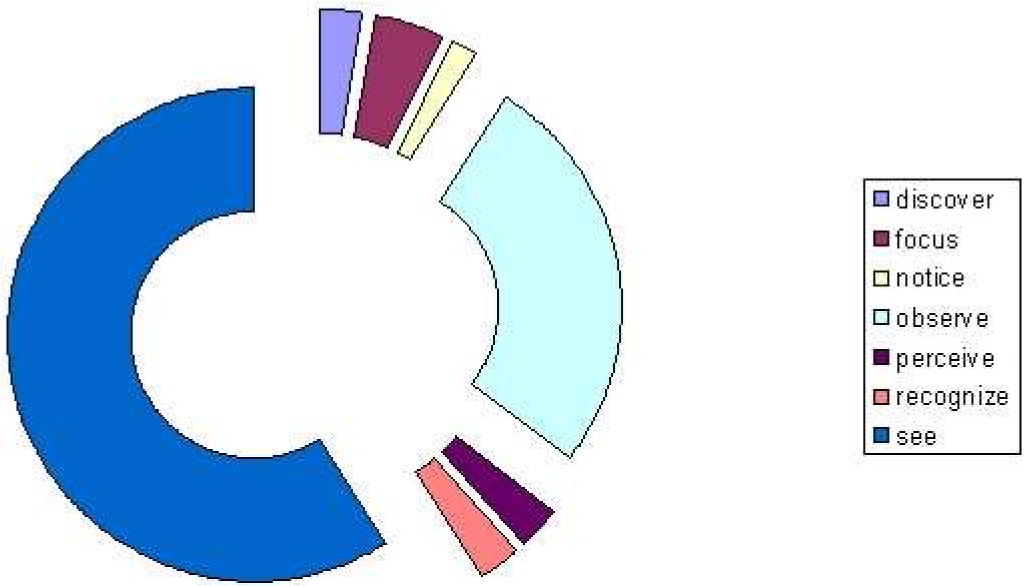


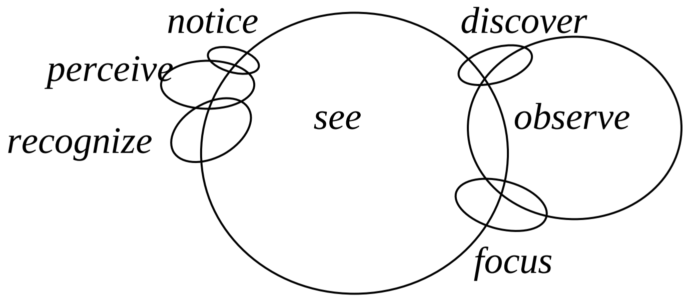
5.6 Groupings: bottom-up view; psychology



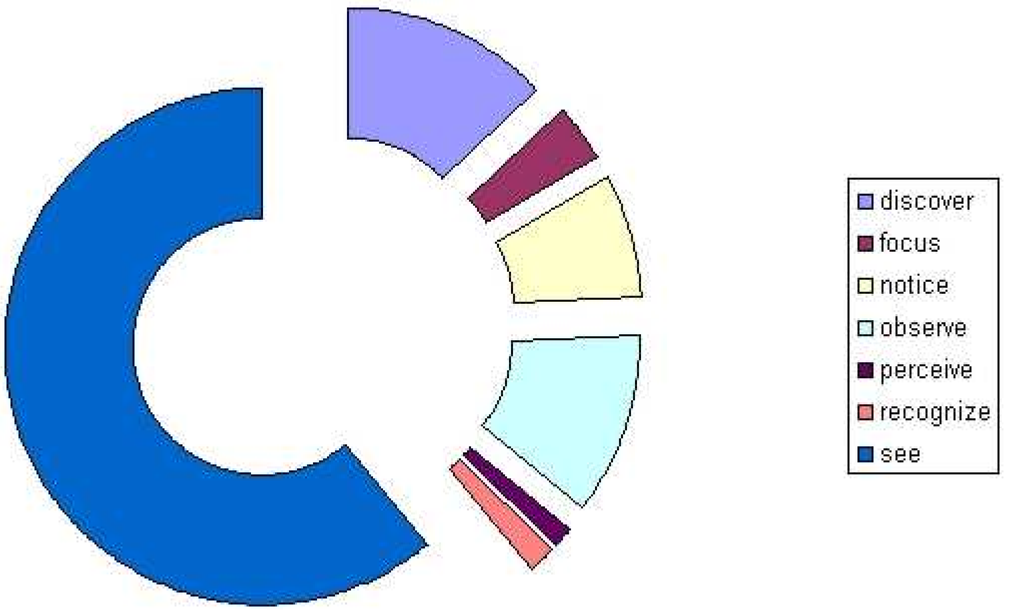


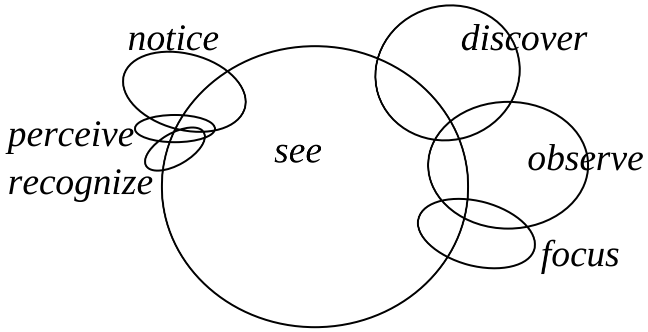
5.7 Groupings: bottom-up view; sciences (academic physics & biosciences)





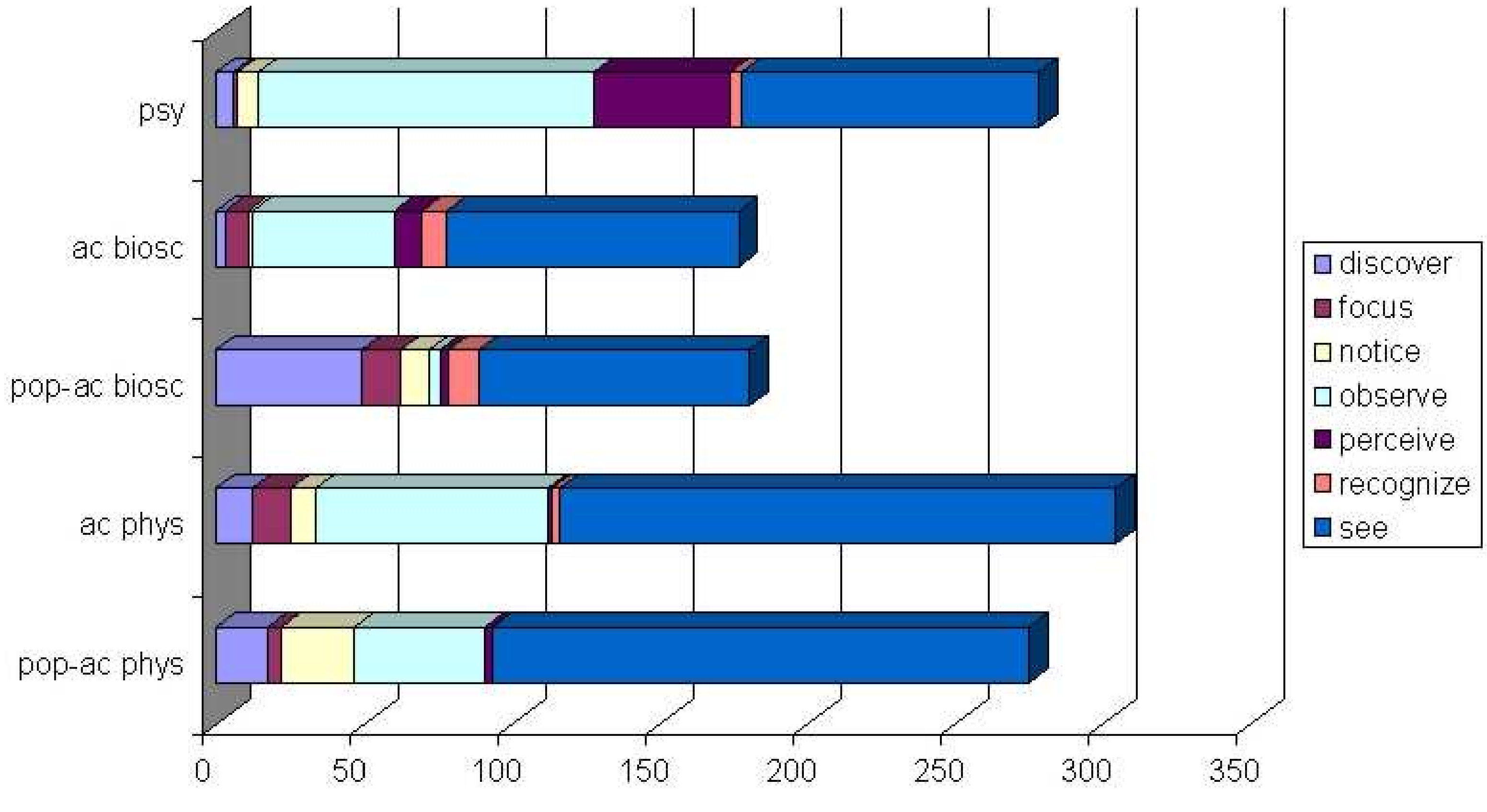
5.8 Groupings: bottom-up view; sciences (popular physics & biosciences)





5.9 Findings

Signatures for all subcorpora (distribution per 100.000 words)



5.10 Findings

Sciences and psychology show distinct signatures

psychology poles: **perceive – see – observe**

academic sciences poles: **see – observe**

popular science poles: **see – agentive $\mathbf{V_{visual}}$**

→ popular science signatures reflect their origins in the academic sciences
→ popular science discourse: the "true" mediator?

6. Perceptual fields/domains for V_{visual}

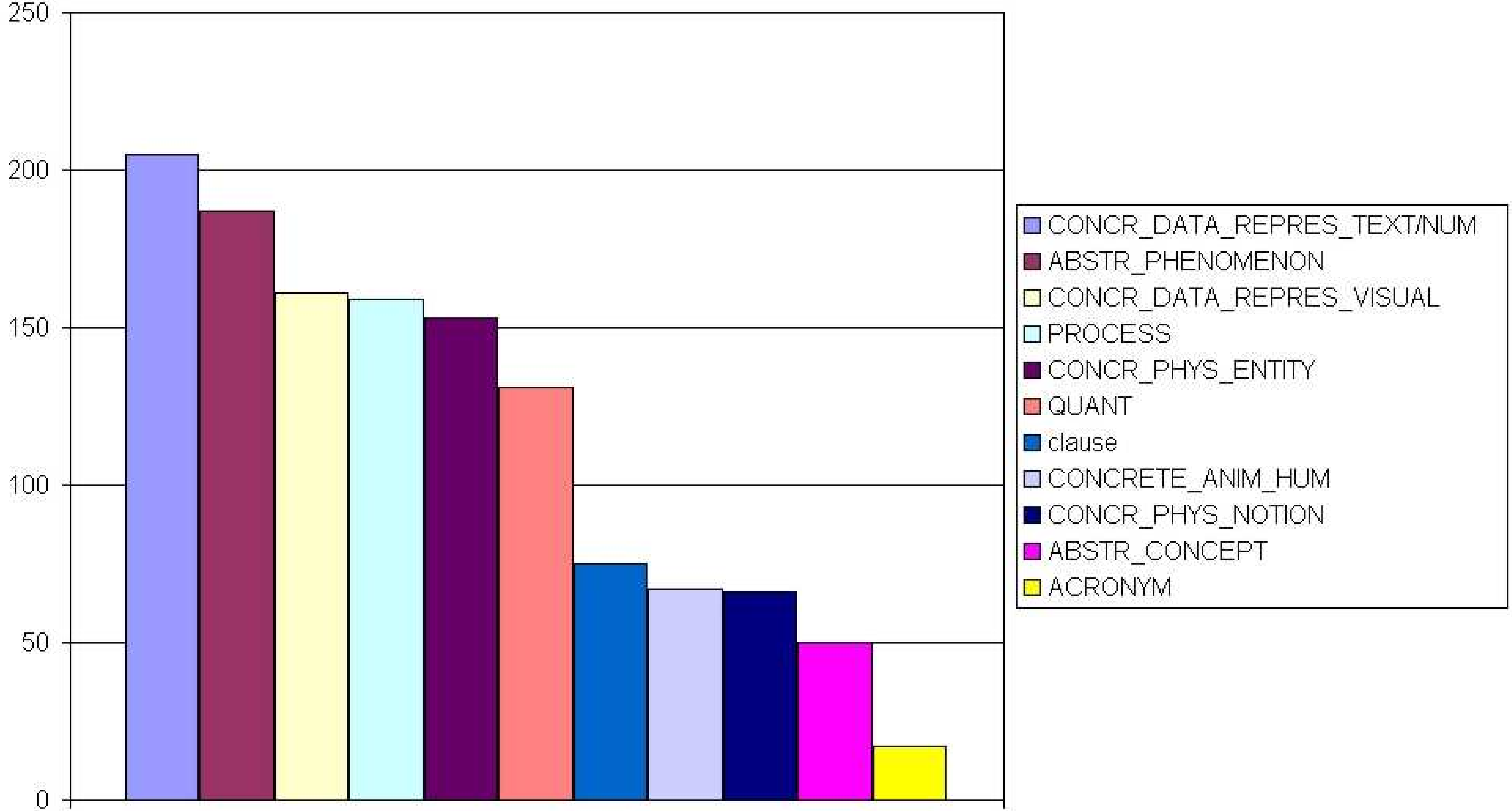
rank	freq	complement	rank	freq	complement
1	75	*that*-clause	21	8	*signal*
2	71	*figure*	22	8	*whether*-clause
3	46	*reference*	23	7	*discussion*
4	27	*effect*	24	7	*hole*
5	27	*table*	25	7	*level*
6	17	*behaviour*	26	7	*pattern*
7	16	*commentary*	27	7	*rate*
8	14	*text*	28	6	*event*
9	13	*method*	29	6	*information*
10	13	*result*	30	6	*number*
11	12	*section*	31	6	*particle*
12	11	*change*	32	5	*amount*
13	11	*expression*	33	5	*graphic*
14	10	*appendix*	34	5	*increase*
15	10	*difference*	35	5	*region*
16	10	*star*	36	5	*variation*
17	9	*material*	37	4	*cluster*
18	8	*cell*	38	4	*courtship*
19	8	*diagram*	39	4	*detail*
20	8	*equation*	40	4	*distribution*

6.1 Target domain ontology for V_{visual}

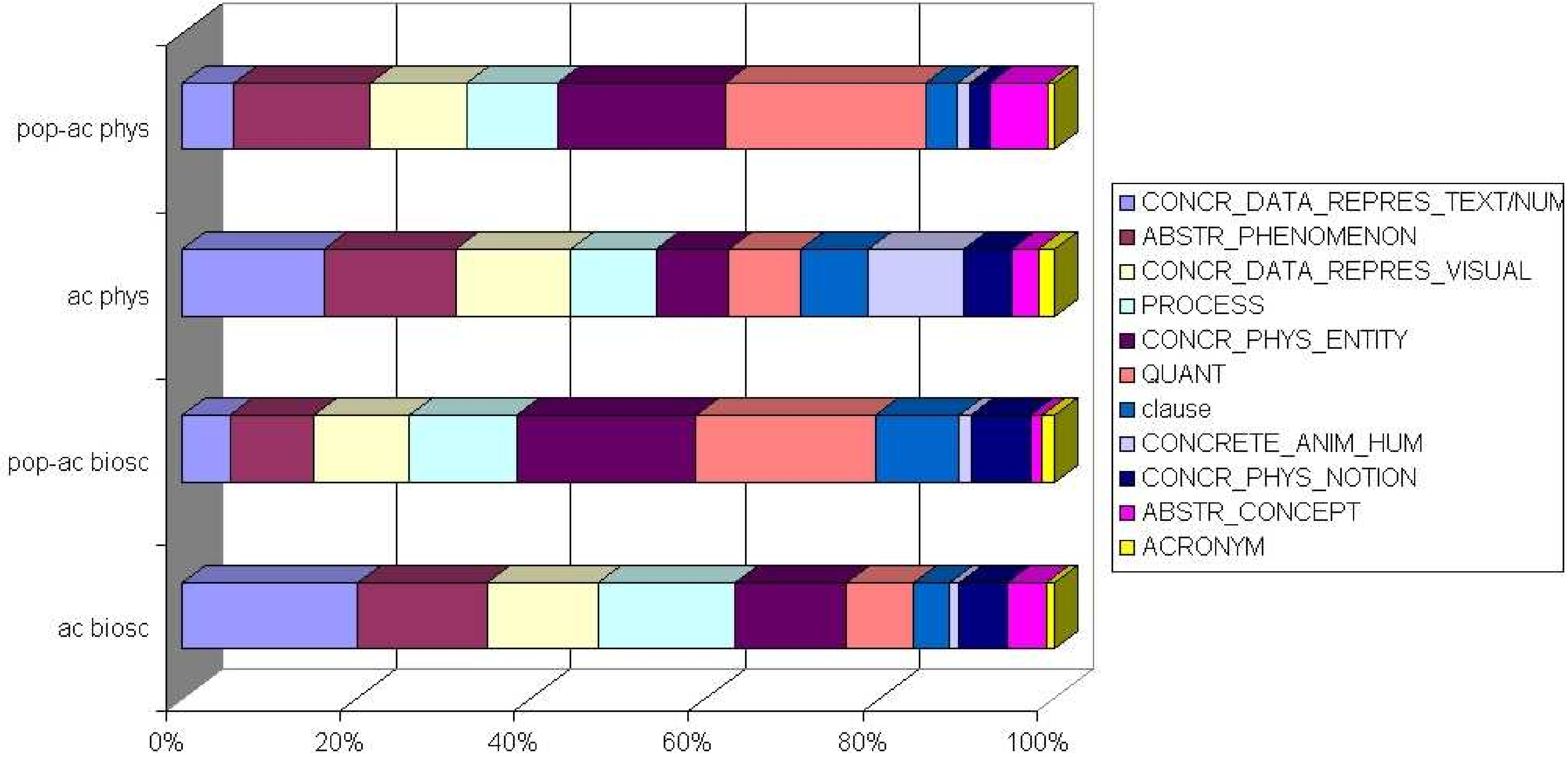
rank	freq	complement	target domains
55	4	*plaque*	CONCR_PHYS_ENTITY
56	4	*structure*	ABSTR_CONCEPT
57	4	*term*	CONCR_DATA_REPRES_TEXT/NUM
58	4	*theory*	CONCR_DATA_REPRES_TEXT/NUM
59	4	*Valentini*	CONCRETE_ANIM_HUM
60	3	*acceleration*	CONCR_PHYS_NOTION
61	3	*affect*	ABSTR_PHENOMENON

target domains	ac biosc	pop-ac biosc	ac phys	pop-ac phys
ABSTR_CONCEPT	24	1	16	9
ABSTR_PHENOMENON	79	7	80	21
ACRONYM	5	1	10	1
clause	22	7	41	5
CONCR_DATA_REPRES_TEXT/NUM	107	4	86	8
CONCR_DATA_REPRES_VISUAL	68	8	70	15
CONCR_PHYS_ENTITY	68	15	44	26
CONCR_PHYS_NOTION	29	5	29	3
CONCRETE_ANIM_HUM	6	1	58	2
PROCESS	84	9	52	14
QUANT	41	15	44	31

6.2 Domain distribution – total values



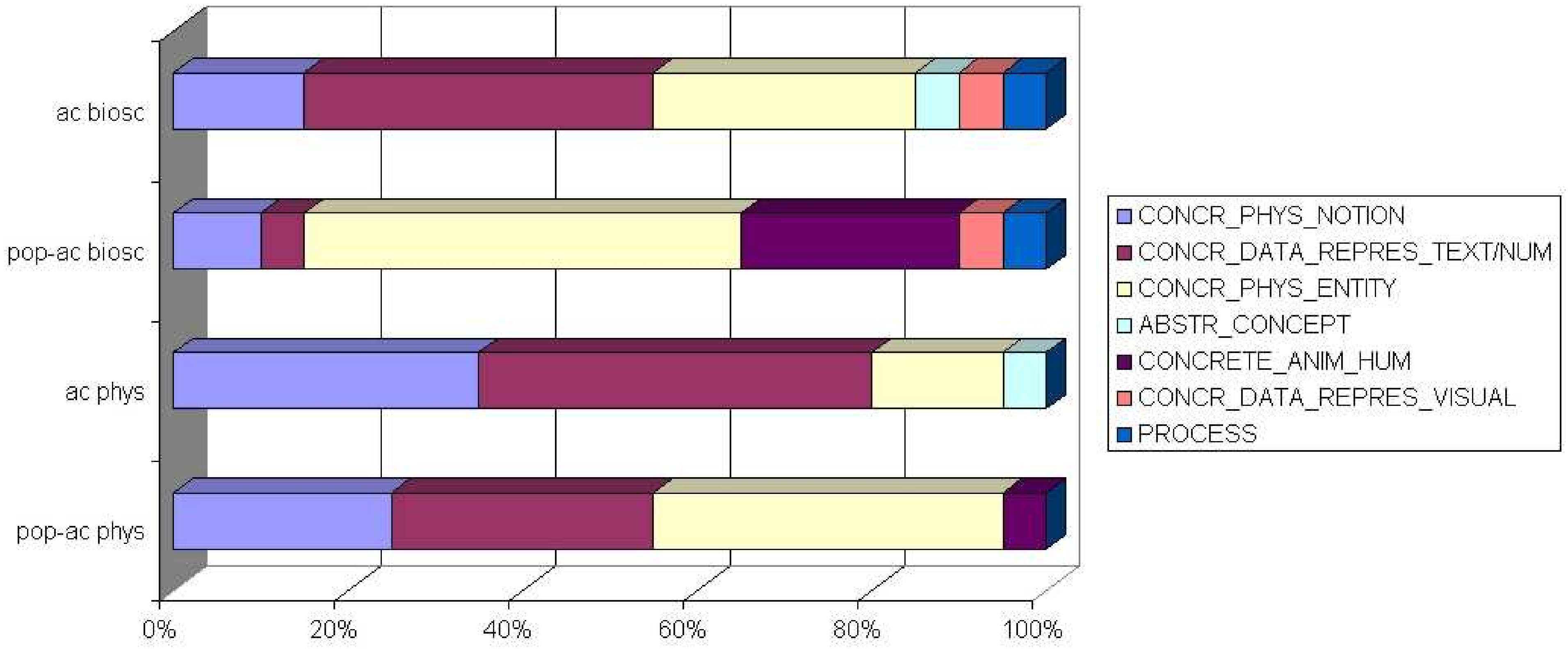
6.3 Domain distribution – subcorpora



6.4 Domains: Frequency view

subcorpus	frequency list (20)
arXiv 0001AX-0046AX	*mass, energy, time, number, quantum, length, hole, stars, case, data, scale, density, state, probability, terms, model, order, code, field, value*
New Scientist-physics 0001NS-0046NS	*quantum, universe, energy, theory, time, space, light, matter, gravity, particles, physicists, years, Earth, holes, idea, issue, page, stars, physics, magazine*
PNAS 0047PN-0107PN	*cells, cell, data, DNA, gene, species, table, rate, time, analysis, results, control, stress, number, group, levels, expression, effects, sequences, mice*
New Scientist-biosciences 0047NS-0107NS	*cells, genes, team, years, researchers, fields, species, field, farmers, water, DNA, gene, people, cell, human, primates, work, way, core, animals*

6.5 Domains: Frequency distribution

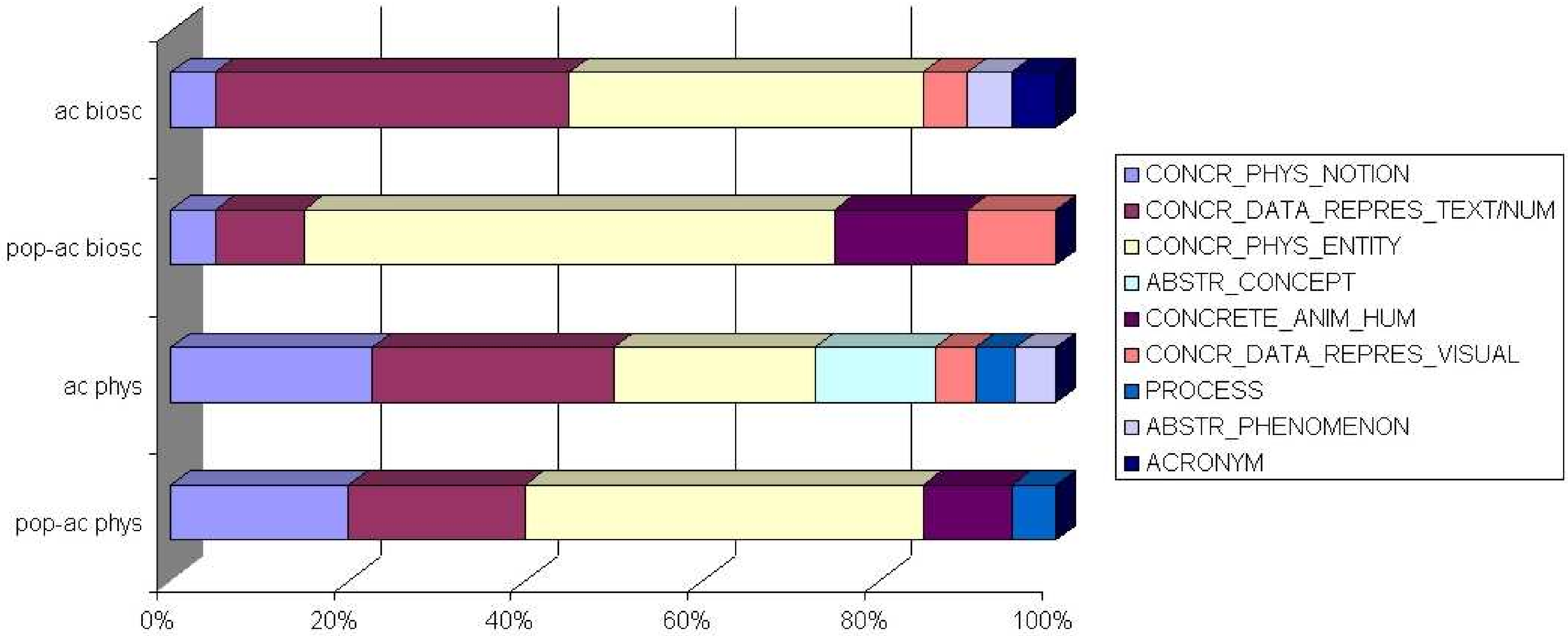


6.5 Domains: Keyness view

subcorpus	keyness list (20)
arXiv 0001AX-0046AX	energy, data, mass, quantum, Pioneer, scale, spacecraft, Earth, model, hole, density, distribution, state, number, theory, probability, constant, acceleration, value, length, results, spin
New Scientist-physics 0001NS-0046NS	quantum, Universe, energy, theory, University, gravity, particles, space, physicists, Earth, physics, relativity, hole, particle, matter, expansion, Einstein, mechanics, alpha, photons
PNAS 0047PN-0107PN	cells, data, DNA, gene, species, Table, analysis, males, www, rate, stress, sequences, levels, University, protein, studies, Science, values, effects, GFP
New Scientist-biosciences 0047NS-0107NS	cells, University, genes, issues, researchers, species, fields, farmers, DNA, gene, primates, page, cell, core, diatom, Beard, ions, shells, Asia, crops

- are V_{visual} relevant, i.e. do they deal with the salient concepts?

6.7 Domains: Keyness distribution



- more diversified
- V_{visual} not significantly used for entities that can be seen (low salience of concreteness)

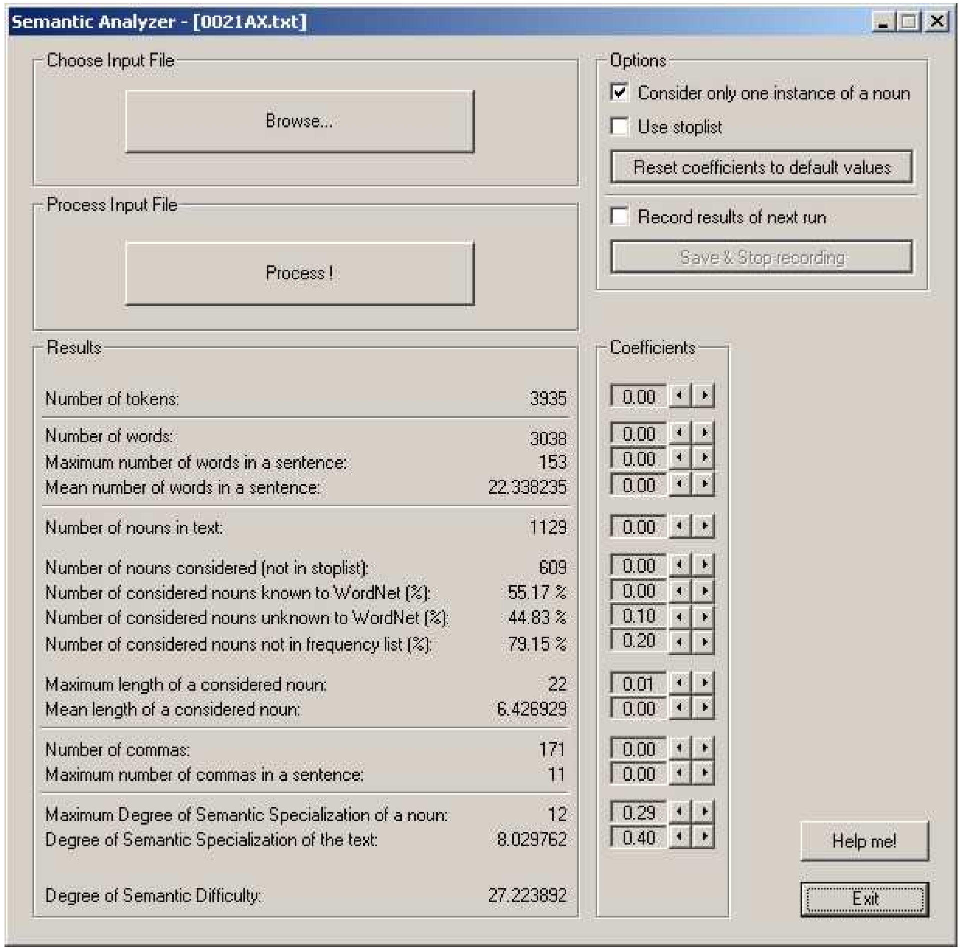
→ V_{visual} mediate between abstract and concrete

7. Adjacent corpus tools

Semantic analysis: Complexity Analyzer (Complexana)

- POS-tags texts
- counts types/tokes
- identifies nominal items
- processes stoplist(s)
- searches ***WordNet*** for nominals

- calculates single score of **semantic complexity**



7.1 Hedges

Academic texts: impart objective information

- frequent nouns, conflated in long words (Biber, Conrad & Reppen 1998)
- little space for subjectivity in natural sciences

But: objective account of the author's involvement or participation in experiments

- author commitment: often stereotypically lexicalised

Cf. **collocational frequency** (Hyland, 2006)

- reader conclusions from involvement/commitment cues

eg. propensity adjustments in IPCC 2007 report versions

the data suggest	→	*the data strongly suggest*
there is some evidence	→	*there is conclusive evidence*

7.2 Functions of hedges

Hedges: a metaphorical device (coined by Lakoff)
properties: to delimit the scope of an utterance via vagueness i.e.

they…

a.) distance the speaker from the utterance

b.) blur quantities, attributes, specifications given in the utterance

c.) relativize notions of truth

Canonical examples: *sort of*, *kind of*

7.3 Usage of hedges

Hedges can be used to estimate therefore

a.) the commitment of a speaker/producer of a text to his/her utterance

b.) the amounts, causes, applications in question and

c.) the distance of the listener to fully commit to the semantic content or truth value of his/her utterance

hedging: enables therefore both to cross borders which are primarily borders of knowledge

7.4 Forms of hedges

Hedges follow pragmatic lexicalization patterns
cut across syntactic classes

→ there is no definite, taggable class of a hedge, only:

a) lexical items

1. reporting verbs (*thinks*, *believes*, *claims*, *says*, etc.);
2. verbs of outcome and resultatives (*succeeds*, *finishes*, etc.)
3. prepositional phrases of mediation such as *by means of, on behalf of, etc.*
4. modal verbs in their deontic and epistemic meaning
5. modal adverbs (probably, likely, possibly, certainly…)
6. quantifiers (some, most, few…)

b) discourse items

7. direct vs. indirect speech
8. the use of the passive voice
9. the use of Lakoffian hedge expressions

c) pragmatic items

8. a wide spectrum of presuppositions the author assumes to be the case (factive, lexical, counterfactual, of the type *When did Smith stop lying?* etc.)
9. entailments that logically follow from what is asserted in an utterance
10. implicatures where information assumed to be known is not stated, communicated but not lexicalised

8. Vagueness vs. Specialization – Subjectivity vs. Objectivity?

High specialization leads to use of very few generic terms
= ontologically “deep” lexical items (**WordNet ontology**)

	academic text 0007AX	**popular academic text 0007NS**
markers of specialization	*conjectures, compactification, coalescence, planetesimals, angular, mesoscopic, gauge field, accretion, radial drag*	*dead stars, cloud of gas, hot star, proto-planetary disc, rogue comets*
markers of vagueness	*suggest X may have, should detect Rc, deviations are weak, may be turbulent*	*it may be hard, can be slow, they probably rebound, could charge up*

	AX	NS01-46	PN	NS47-107	NS all	AX+PN	all
semantic parameters							
mean complexity	23.61	19.11	26.28	19.79	19.50	25.06	22.37
SD complexity	2.12	1.26	1.28	1.24	1.25	2.17	3.31
Max. degree of sem. spec.	13.69	12.78	15.53	13.84	13.38	14.69	14.06
Degree of sem. spec.	8.08	8.09	8.19	8.26	8.19	8.14	8.16

syntactic parameters							
SD unknown	7.49	3.85	5.38	3.34	3.59	6.87	11.92
Max. noun length	24.17	22.83	39.58	17.38	19.72	32.55	26.34
Mean noun length	6.54	6.89	6.82	6.78	6.83	6.69	6.76
number of commas	191	42	463	28	34	339	191
Max. commas/sentence	11	4	23	3	3	18	11

lexical parameters							
mean length	3113	812	4359	500	634	3790	2262
mean vocab. unknown	30.05	12.03	34.59	10.94	11.41	32.52	22.30

8.1 Mean Complexity (Complexana Scores)

Type/Domain	Physics/Astrophysics	Biosciences	Psychology
Specialized academic	23.61	26.28	22.37
Popular academic	19.11	19.79	19.36

all popular versions show ontologically "shallower" semantic items

9. Conclusion

- metaphor relevant in the visual perception
- manners of perception generally underused in academic prose
- usage of verbs of perception in psychology and sciences: differences in agency and factivity
- mediator between the "two cultures" isolated: **popular science**

→ verbs of perception in metaphorical use:

a) more abstract, thus more mediating in popular science
b) more direct, concrete, and thus less metaphorical
in the academic sciences