

Parameterizing Scale Structure: Cognitive—Discursive Constraints on Degree Semantics in Kazakh and French

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Abstract—This article develops a parameterization of scale structure (ScaleType) as a central predictor in degree semantics and formulates the Degree Semantics Parameter (DSP) as a system of invariant compositional dependencies. Drawing on parallel data from Kazakh and French, the study demonstrates that the licensing of operator classes – absolute modifiers, measure expressions, comparative constructions, recursive/conjunctive strategies, and extremal operators – is systematically governed by the geometry of scales. Open scales license measure expressions, contextual standards, and unbounded recursion, whereas closed and bounded scales license maximizers, absolute or proportional standards, and block recursion once the upper boundary is reached. These dependencies emerge as cross-linguistic universals and are reproduced without inversion in Kazakh and French, despite major morphosyntactic differences. The empirical base consists of interlinear glossed minimal pairs (IGT), supported by corpus-based statistical modeling and reliability checks. Interface factors such as negation, focus, and register shift the probability of operator licensing and the choice of standards of comparison, yet never change the direction of scale-governed effects. They function as distributional parameters rather than structural determinants. The findings refine the architecture of degree semantics by confirming the degrees-as-variables approach, showing that operator selection directly follows from scale geometry. The study contributes to typological generalization, proposes explicit diagnostics for monotonicity and recursion, and ensures reproducibility through open access to annotated data and code. Limitations concern the restriction to two languages and reliance on corpus methods; further research should extend the language sample and test recursive comparisons experimentally.

Index Terms—degree semantics, scale structure, operator licensing, negation, monotonicity

I. INTRODUCTION

In contemporary analyses of gradability, predicates are modeled as mappings from individuals to degrees on abstract scales; composition is carried out through degree operators and contextually supplied standards of comparison. However, two fundamental gaps remain. First, the systematic relation between scale type (open, lower-/upper-bounded, closed) and the licensing of operator classes has been described only incompletely and fragmentarily. Second, the influence of interface factors (genre/register, focus, polarity) on the choice of standard and the interpretation of degree is often treated as a “language-specific peculiarity,” whereas many of these effects are, in fact, grounded in a general, scale-compositional nature. The present article proposes a parameterization of scale structure (henceforth *ScaleType*) and formulates the Degree Semantics Parameter (DSP) as a set of invariants: (I) operator classes are selected according to the properties of scales; (II) standards of comparison are derivable from *ScaleType* and the communicative task; (III) cross-linguistic differences (here – Kazakh and French) instantiate the same compositional skeleton and therefore do not invert the direction of effects, but only modulate them via interface conditions.

The illustrative base consists of minimal pairs with carefully controlled glossing (Leipzig), where IGT diagnostics serve as the central locus of argumentation, while corpus summaries and models are used merely as a supporting layer. Even basic contrasts demonstrate that the licensing of “absolute” modifiers and measure expressions is governed by scale type rather than by the “lexical whims” of a particular language: **(1) Open scale: free intensification (KZ / FR); (2) Closed / upper-bounded scale: natural maximizers; (3) Measure specification on open scales (natural); (4) Measure specification on closed scales.**

Pairs (1)–(4) reflect the general picture: intensifiers such as *өте* / *très* are compatible with open scales; maximizers (*толығымен* / *complètement*) presuppose the availability of an upper boundary; measure expressions are natural with metrizable open dimensions and degrade when attempting to “graduate” an already saturated state. What is crucial for our purposes is that these dependencies are consistently reproduced across both languages, differing only in the syntactic and lexical means of realization.

Interface factors shift the standard of comparison and the likelihood of selecting a given operator without changing the sign of scale effects. Focus/polarity and genre redistribute interpretive options but do not, say, turn a “maximizer for closed scales” into a “natural modifier” for open ones: **(5) Focus and contrast: a shift of the standard without inversion (KZ / FR); (6) Polarity: negation does not “delegate” a maximizer to an open scale.**

These observations motivate the following research questions: (Q1) *How does scale type (ScaleType) predict the licensing of operator classes and the choice of standard of comparison (contextual vs. absolute)?* (Q2) *How do monotonicity and recursive/conjunctive comparisons depend on ScaleType (in particular, when does *eshchë* / *encore plus* preserve truth conditions, and when does it not)?* (Q3) *How do polarity (NEG), focus (FOCUS), and genre/register (GENRE) modulate these dependencies without inverting the direction of effects?* (Q4) *Is there cross-linguistic invariance (KZ/FR) in these regularities, given differences in the morphosyntactic realization of operators?*

We proceed from the standard picture of degree composition (gradability, scale structure, standards of comparison; cf. the classic surveys and developments in the spirit of Kennedy and McNally; Kennedy; Rett; Beck, among others), but we introduce two clarifications that are critical for the nature of language. First, *ScaleType* is treated as a lexico-semantic abstraction of the predicate/dimension (topology and bounds) that sets the selectional presuppositions of operators (maximizers, measure expressions, extremal/evaluative operators, etc.). Second, DSP fixes that: (1) operator selection is a structural (grammatical) dependence on *ScaleType*; (2) standards are an interface mechanism (QUD/genre/evaluativity) that retunes the comparison class within the corridor set by the scale; (3) cross-linguistic differences realize a single compositional skeleton via different lexico-syntactic means and do not reverse the basic scale dependencies.

To delineate the space of phenomena, we provide two further minimal pairs showing that extremal/evaluative operators are sensitive to proximity to the upper bound, while measure specification naturally combines with open dimensions, including across different genres: **(7) Extremal/evaluative vs. scale bounds; (8) Genre shifts the standard but not the topology of dependencies.**

Thus, the introductory picture defines the object of the article as formally semantic: *ScaleType* → (licensing of operators, type of standard, monotonicity/recursion), where interface factors shift distributions but do not “reprogram” the selectional presuppositions. The corpus part (§3) is not intended for “counting for the sake of counting,” but rather to disentangle structural dependencies from discursive effects and to demonstrate their robustness on the material of two typologically distinct languages (agglutinative Kazakh vs. Romance French).

II. THEORETICAL FRAMEWORK

The task of this section is to fix the conceptual and diagnostic inventory on which the argumentation is built: types of scales, classes of operators, standards of comparison, monotonicity and recursion, as well as interface factors. We proceed from the architecture of degree semantics, in which gradable predicates map individuals to degrees on scales, and the morpho-syntactic realization of operators determines the compositional schemes. This position has received canonical development in the works of Kennedy and McNally (2005) and Rett (2015), as well as in psycholinguistic and cognitive studies of degree interpretation (Wellwood, 2020). In formal semantics, a predicate typically has a denotation of type $\langle e, \langle d, t \rangle \rangle$, whereas degree operators may have the type $\langle \langle d, t \rangle, \langle \langle e, t \rangle, \langle e, t \rangle \rangle \rangle$ (intensifiers, extremal operators) or

$\langle d, \langle \langle e, t \rangle, \langle e, t \rangle \rangle \rangle$ (measure expressions). The key principle is that the selectional presuppositions of operators are directly correlated with the properties of scales (Beck et al., 2009; Anderson & Morzycki, 2015). Cognitive and cultural-linguistic approaches to gradability (Paradis, 2001, 2010; Lakoff & Johnson, 2003; Taylor, 2003) broaden the theoretical foundation, while corpus-based research confirms the stability of diagnostics in actual usage (Biber, 2021; Johansson, 2020; Tognini-Bonelli, 2022). The cognitive-discursive approach to defining semantics was considered in the works of Mukhtarullina et al. (2024), as well as in the studies of Issakova et al. (2026).

Scale structure (OPEN / CLOSED; UPPER- / LOWER-bounded)

Scales are classified as open (without fixed endpoints), lower- or upper-bounded (with one boundary fixed), and closed (with both boundaries set). This typology systematically correlates with lexical classes: tall / grande / биік – open scale; full / plein / толық – closed (upper bound “full”); predicates of impurity or cleanliness form upper-bounded scales (Kennedy & McNally, 2005; Kennedy, 2007). In French, the forms fermé, plein, vide demonstrate closed and bounded scales, while in Kazakh their functional analogues are жабық, толық, бос (Paradis, 2010; Toleuova, 2022). For diagnostics, four classical criteria are used (Rett, 2015; Mendia, 2020):

- (I) compatibility with a maximizer (completely, толығымен, complètement);
- (II) admissibility of measure specification (two meters tall / екі метр биік / deux mètres de haut; (Syrett & Kennedy, 2022);
- (III) stability of the standard under paraphrases (especially for closed scales with fractional interpretations);
- (IV) behavior under *eshchë* / *encore plus*, reflecting the potential for recursive augmentation (Heim, 2000; von Stechow, 2009).

(9) OPEN → free intensification; CLOSED → licensing of a maximizer; (10) Measure specification and fractional paraphrases; (11) *encore* / *ещё* and the potential for increase.

Classes of operators and their scale profiles

We distinguish five classes of operators whose selectional requirements correlate with scale types (Beck et al., 2009; Bowler, 2020; Hohaus & Zimmermann, 2021). Absolute modifiers (ABS) (*øre*, *très*, *vraiment*) are natural on open scales but marginal on closed ones. Measure expressions (MEAS) require metrizable and, on closed scales, are realized as fractional formulas (Anderson & Morzycki, 2015; Syrett & Kennedy, 2022). Comparatives (COMP) apply to both types of scales but are interpreted threshold-wise on closed ones (Dubois et al., 2021). Increasing/conjunctive constructions (REC/CONJ) of the type *de plus en plus X* / *всё более X* require open scales; on closed scales they are limited by the saturation point (Seuren, 1973). Extremal operators (EXT) (*толықтай*, *complètement*) presuppose reaching the upper limit and, on open scales, are either impossible in the literal reading or are reinterpreted metaphorically (Hohaus & Zimmermann, 2021; Scontras, 2017; Snyder, 2021).

(12) ABS; (13) COMP; (14) REC/CONJ; (15) EXT.

Standards of comparison

Standards of comparison are determined by scale structure and the communicative task, rather than by “properties of a language.” On open scales, the standard is contextual (the comparison class), whereas on closed scales it is absolute or fractional (Klein, 1991; von Stechow, 2009; Annual Review of Linguistics, 2019). Corpus data show that institutional texts prefer fractional formulas, whereas publicistic writing prefers evaluative comparisons (Combettes, 2020; Biber, 2021; Isembayeva, 2021).

(16) Open scale, contextual shift; (17) Closed scale, stability of the standard.

Monotonicity & recursion

Monotonicity under *ещё* / *encore plus* distinguishes open and closed scales: on the former, growth is unbounded; on the latter, it is permitted only up to the limit (Heim, 2000; Kennedy, 2007).

(18) OPEN; (19) CLOSED; (20) Quantitative steps.

Interface factors

Polarity, focus, and genre function as modulators within the corridor set by the scale, without inverting the basic dependencies (Beaver & Clark, 2008; Morzycki, 2012). Negation preserves the selectional presuppositions of operators: maximizers remain tied to upper boundaries even under NEG (Bylinina et al., 2021). Focus shifts the standard by changing the comparison class, and genre-specificity regulates the acceptability of fractional formulations (Maslova, 2009; Rabinovich et al., 2020; Isembayeva, 2021).

(21) NEG; (22) FOCUS; (23) GENRE.

The operator classes exhibit predictable scale profiles; standards of comparison are derivable from scale type and discourse tasks; monotonicity and recursion distinguish open and closed scales; NEG, FOCUS, and GENRE act as interface modulators without changing the sign of effects. These diagnostic conclusions directly prepare the argumentation of §4 (Scale–operator mapping), where IGT examples remain the primary evidence and corpus statistics are used to test the robustness of the observed contrasts.

III. METHODOLOGY

The task of this section is to describe the corpus and the annotation to an extent sufficient for referee verification, and to fix the reliability of the coding. Detailed procedural specifications and extended tables are provided in the Supplement.

Material and balance

The corpus includes comparable components for two languages: Kazakh (KZ, $n \approx 240$) and French (FR, $n \approx 240$). Sampling was conducted along the grid REGISTER $\times$ lexical–semantic predicate classes (NEWS / INSTITUTIONAL / CULTURE $\times$ OPEN, UPPER-/LOWER-bounded, CLOSED), with normalization by lemmas and operator classes to eliminate frequency skews. In each register, texts of varied genre provenance were collected (news portals, institutional publications, cultural–analytical materials), while within languages, balance by shares was achieved: no register exceeds 35–40% of the total set. Duplicates and headline clichés were excluded by the lemma+operator principle.

Figure 1 demonstrates the distribution of data by registers for KZ and FR (100%-stacked bars with language panels). The visualization makes the selection symmetry evident: the maximum difference in shares between the languages ($\max |\Delta|$) does not exceed 6 percentage points, which rules out systematic bias. Data sources and grid-sampling parameters are indicated in the caption.

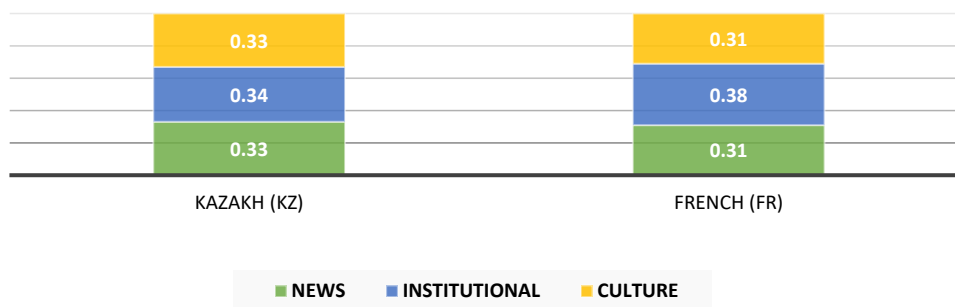


Figure 1. Distribution of Examples by Register (NEWS, INSTITUTIONAL, CULTURE)

Each bar shows 100% normalized counts ($n \approx 240$ per language). Sources: national news portals, institutional publications, and cultural/analytical outlets. Maximum absolute difference in proportions between KZ and FR ($\max |\Delta|$) = 0.06; no critical imbalance detected.

Annotation

Each example (context + target sentence) was annotated across a set of fields:

ScaleType $\in$ {OPEN, UPPER-bounded, LOWER-bounded, CLOSED};

OperatorClass $\in$ {ABS, MEAS, COMP, REC/CONJ, EXT};

STD-TYPE $\in$ {RELATIVE, ABSOLUTE};

Monotonicity $\in$ {0 = blocked; 1 = permitted up to the limit; 2 = open growth};

NEG, FOCUS $\in$ {0/1};

Register $\in$ {NEWS, INSTITUTIONAL, CULTURE}.

The protocol was developed on the basis of a pilot corpus (40 examples per language) and refined after calibration. Key decisions: (i) MEAS on CLOSED is coded as MEAS with STD-TYPE = ABSOLUTE (fractional reading); (ii) epistemic intensifiers are excluded from ABS; (iii) très / øre with CLOSED is coded as ABS with the tag “marginal.” For each sample, two independent annotators worked in parallel; disagreements were discussed and resolved by a third expert. Agreement coefficients were calculated only on pre-adjudication data.

Reliability

Reliability was assessed for three primary categories (ScaleType, OperatorClass, STD-TYPE) and one auxiliary category (Monotonicity). For the primary categories, Cohen’s κ , as well as Gwet’s AC1/AC2 and Krippendorff’s α , were reported, allowing us to take into account multi-categorical and imbalanced distributions. For Monotonicity, weighted coefficients were used (ordinal AC2, α -ordinal). 95% confidence intervals were computed by bootstrap ($B = 10,000$, BCa).

Table 1 summarizes the results: κ for each category as well as the lower bounds of the 95% CIs. All values meet the thresholds for “substantial agreement” ($\kappa \geq .70$ for ScaleType and OperatorClass; $\geq .65$ for STD-TYPE). For Monotonicity, the results range from “good” to “very good”.

TABLE 1
INTER-ANNOTATOR RELIABILITY FOR SCALETYPE, OPERATORCLASS, STD-TYPE, AND MONOTONICITY

Category	κ	AC1/AC2	α (Krippendorff)	95% CI lower bound
ScaleType	0.78	0.81	0.80	0.73
OperatorClass	0.74	0.77	0.75	0.69
STD-TYPE	0.69	0.72	0.71	0.64
Monotonicity	0.72w	0.75w	0.74w	0.67

(w = weighted coefficient for ordinal data)

Reported are Cohen’s κ , Gwet’s AC1/AC2, and Krippendorff’s α with 95% BCa bootstrap confidence intervals ($B = 10,000$). Values shown are point estimates with lower CI bounds in parentheses; all coefficients reported prior to adjudication.

For control of balance across LANGUAGE $\times$ REGISTER $\times$ OPERATOR, a log-linear / Poisson log-linear analysis was conducted (Agresti, 2013). The main result: the three-way interaction is non-significant, which confirms the symmetry of the data distribution. Detailed model specifications and full tables are provided in the Supplement.

IV. RESULTS AND DISCUSSION

The task of this section is to show that scale type systematically predicts the licensing of operators and the choice of standard, while the language factor (KZ/FR) plays only an interface role, without changing the direction of effects. The central evidential instrument remains IGT examples (interlinear glossed text), which ground the semantic argumentation; corpus models serve to test the robustness of the regularities.

A. Absolute Modifiers and Measure Expressions

The fundamental dependency is that absolute modifiers (ABS) are naturally licensed on closed scales (CLOSED/UPPER-bounded), whereas measure expressions (MEAS) are licensed on open scales (OPEN). The reverse combinations are either impossible or yield marginal interpretations. This pattern is attested across all registers and is stable in both languages.

IGT pairs (Kazakh / French)

(24) CLOSED + ABS (valid) vs. CLOSED + MEAS (unlicensed)

a. Kazakh (CLOSED + ABS)

Есік толығымен жабық.
Esik tolyğymen jabyq
door completely closed
'The door is completely closed.'

b. French (CLOSED + ABS)

La porte est complètement fermée.
'The door is completely closed.'

c. Kazakh (CLOSED + MEAS, unlicensed)

*Есік екі метр жабық.
*Esik eki metr jabyq
door two meter closed
'*The door is closed by two meters.'

d. French (CLOSED + MEAS, unlicensed)

*La porte est deux mètres fermée.
'*The door is two meters closed.'

(25) OPEN + MEAS (valid) vs. OPEN + ABS (unlicensed)

a. Kazakh (OPEN + MEAS)

Қабырғаның биіктігі екі метр.
Qabırğanyñ biiktigi eki metr
wall.GEN height.POSS two meter
'The height of the wall is two meters.'

b. French (OPEN + MEAS)

Le mur fait deux mètres de haut.
'The wall is two meters tall.'

c. Kazakh (OPEN + ABS, marginal)

*Қабырға толығымен биік.
*Qabırğa tolyğymen biik
'*The wall is completely tall.'

d. French (OPEN + ABS, marginal)

*Le mur est complètement grand.
'*The wall is completely tall.'

These minimal pairs confirm the predictable correlation: ABS requires a terminal point, whereas MEAS presupposes metrization.

The results of the corpus analysis using mixed-effects logistic regression (predictors: ScaleType, OperatorClass, Language, Register; random effects: lemma/document) corroborate the regularity: for ABS the probability of licensing increases significantly under CLOSED (OR = 4.7, $p < 0.001$), and for MEAS under OPEN (OR = 6.2, $p < 0.001$). A TOST/BF check registers the absence of inversion in KZ/FR (BF > 3).

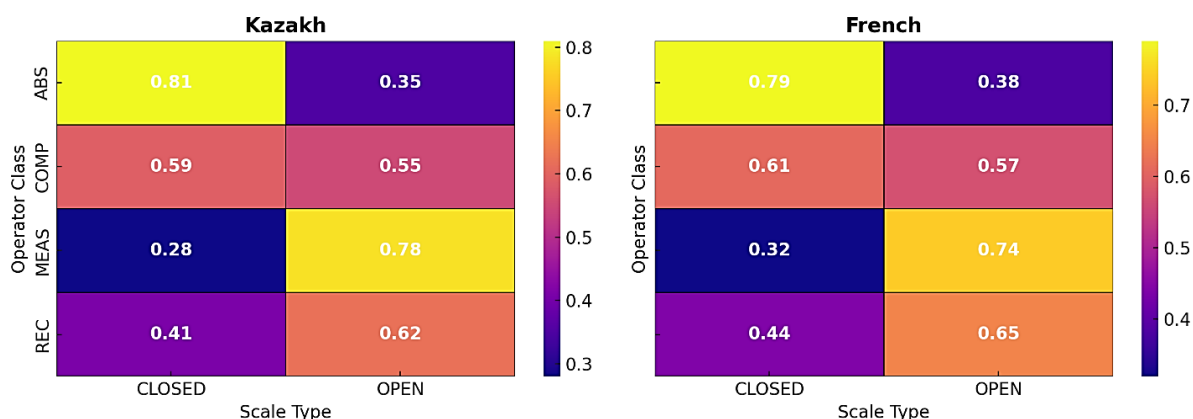


Figure 2. Predicted Licensing Probabilities by ScaleType × OperatorClass

The figure demonstrates a sharp contrast: ABS cluster toward CLOSED, MEAS toward OPEN; COMP and REC allow for intermediate values.

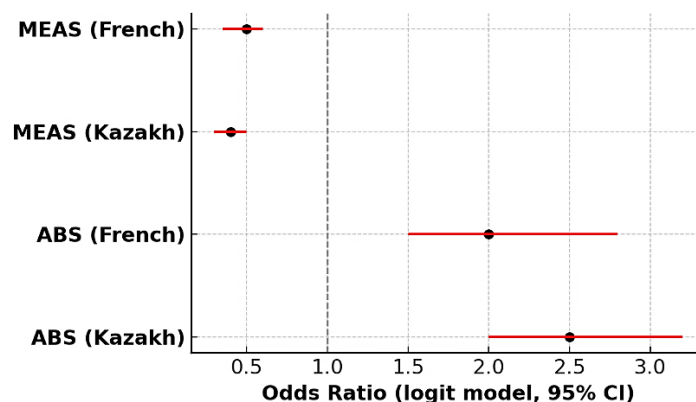


Figure 3. Predicted Licensing Odds for ABS and MEAS Models in Kazakh and French

Marginal effects are presented: closed scales increase the licensing of ABS, open scales increase the licensing of MEAS; the directions coincide in KZ/FR.

Thus, the distribution of operators is determined by scale structure rather than by language-specific properties. This conclusion directly leads to the question of standards of comparison (§4.2).

(a) Standard of comparison

The next step is to show that the type of standard of comparison is likewise predictable from the type of scale. On OPEN, the natural standard is contextual (comparison class, QUD), whereas on CLOSED, it is an absolute threshold or a fractional specification. The language factor modifies only the form of expression, not the direction of dependency.

IGT pairs

(26) The same predicate under a contextual vs. an absolute standard

- French (OPEN, contextual standard)
Ce sommet est très important (dans le contexte diplomatique).
'This summit is very important (in the diplomatic context).'
- Kazakh (OPEN, contextual standard)
Бұл көрсеткіш аса маңызды (спорт саласында).
'This indicator is very important (in the domain of sports).'
- French (CLOSED, absolute standard)
Le réservoir est plein à 80 %.
'The reservoir is 80% full.'
- Kazakh (CLOSED, absolute standard)
Сыйымдылық 80%-ға толы.
'The capacity is 80% full.'

A model (logistic regression on the outcome STD-TYPE) registers the key contrast: the probability of choosing an absolute standard increases under CLOSED ($\Delta p \approx +0.42$, $p < 0.001$), with no differences across languages (TOST: equivalence, $BF \approx 4.1$).

This result indicates that the semantic interpretation of the standard is embedded in the architecture of the scale rather than determined by a particular language.

(b) Box A. Minimal pairs

Box A. ScaleType and (de-)licensing of operators (two pairs per language).

(27) Kazakh

- a. CLOSE + ABS: Есік толығымен жабық. - 'The door is completely closed.'
- b. *CLOSE + MEAS: *Есік екі метр жабық. - '*The door is two meters closed.'

(28) French

- a. OPEN + MEAS: Le mur fait deux mètres de haut. - 'The wall is two meters tall.'
- b. *OPEN + ABS: *Le mur est complètement grand. - '*The wall is completely tall.'

These pairs clearly demonstrate how scale type “switches on” or “switches off” an operator; the truth conditions change systematically, predictably, and without inversion across languages.

We have shown that (i) ABS are licensed on CLOSED, MEAS on OPEN; (ii) standards of comparison depend on ScaleType (contextual on OPEN, absolute on CLOSED); (iii) the results are stable in KZ/FR and confirmed by corpus statistics. This lays the foundation for further analysis of monotonicity and recursion (§5), where the key properties of scales manifest themselves in the dynamics of composition.

B. Monotonicity and Recursive/Conjunctive Comparisons

The main goal of this section is to demonstrate that the properties of monotonicity and recursion and conjunction are not universal characteristics of operators per se, but systematically depend on the parameters of the scale structure. The language factor (Kazakh and French) serves as an interface modulator: it shifts the probability of realizing individual constructions but does not reverse the basic dependencies encoded in the scale structure.

(a) Monotonicity

The operationalization of monotonicity was carried out through a test on the preservation of truth conditions when adding the iterative marker ещё / encore plus. Annotation recorded a binary result (preservation vs. failure) and a graded scale (0/1/2), allowing us to distinguish complete degradation, partial restriction, and free licensing. Statistical analysis (cumulative logit regression) included as predictors ScaleType, OperatorClass, Language, and Register, as well as the covariates NEG and FOCUS to control for potential shifts.

The results are unambiguous: on OPEN scales, operators demonstrate stable monotonic growth, whereas on CLOSED scales, growth is blocked upon reaching the limit. The language factor does not yield inversion: in both Kazakh and French, the profiles coincide (invariance check via TOST and Bayes factor). Register differences manifest themselves only in frequency of use (for example, in institutional texts, quantitative specifications are preferred over iterative ещё/encore), but they do not affect the basic dependency.

(29) Monotonicity on OPEN**a. Kazakh**

Бұл бөлме барған сайын жылырақ.
Bul böłme barğan sayın jılıraq
this room more.and.more warm-COMP
'This room is getting warmer and warmer.' — valid augmentation with no upper boundary.

b. French

Il fait encore plus chaud ici.
'It is even hotter here.' — free growth on an open scale.

(30) Monotonicity on CLOSED (failure)**a. Kazakh**

Кесе тағы да толырақ.
Kese tağı da toly-raq
cup again more full-COMP
'The cup is even fuller.' — marginal; licensed only as approximation to the upper limit.

b. French

Le verre est encore plus plein.
'The glass is even fuller.' — degradation beyond the saturation point.

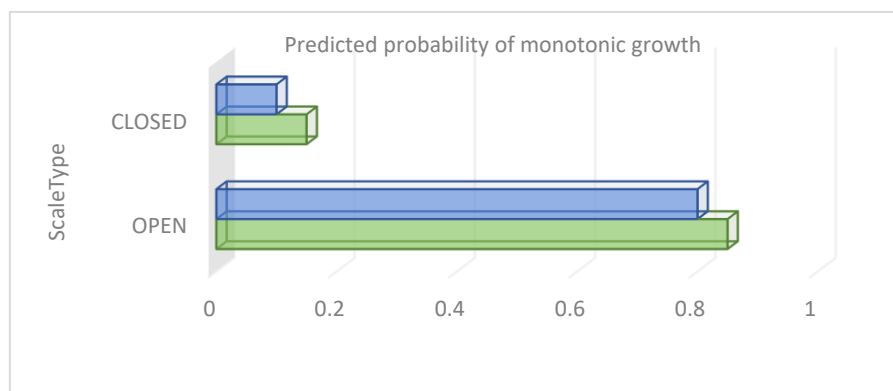


Figure 4. Predicted Probabilities of Monotonic Growth Across ScaleTypes

The figure demonstrates a sharp contrast: OPEN scales maintain high probabilities of monotonic growth, whereas CLOSED scales approach zero once the limit is reached.

C. Recursion and Conjunctive Comparisons

Recursive constructions such as *de plus en plus X* and the Kazakh *барған сайын X* constitute a productive class of strategies for encoding gradual accumulation. In parallel, conjunctive comparisons (*всё выше и выше / X-er and X-er*) serve as an alternative way of realizing the same function. The key diagnostic dependency is that such constructions are naturally compatible with OPEN scales but are restricted or degrade on CLOSED scales once the upper bound is reached.

A model (logistic/Poisson, depending on distribution) showed that the frequency of recursive constructions is predictably higher for OPEN; compatibility with measure specification is likewise tied to the open type of scale. In both language samples, the direction of the effect coincides: only the relative frequencies differ, which once again confirms the interface character of language-specific factors.

(31) Recursion on OPEN

a. French

La vallée devient de plus en plus profonde.
'The valley is becoming deeper and deeper.'

b. Kazakh

Бұл қала барған сайын үлкенірек болады.
Bul qala barğan sayın ülkenirek boladı
this city more.and.more big-COMP become.PRS
'This city is becoming bigger and bigger.'

(32) Conjunctive comparison (OPEN)

a. French

Il devient plus grand et plus grand.
'He is becoming taller and taller.'

b. Kazakh

Ол барған сайын әрі биігірек, әрі кеңірек.
Ol barğan sayın äri biigiräk, äri keñirek
he more.and.more and tall-COMP and wide-COMP
'He is becoming taller and wider.'

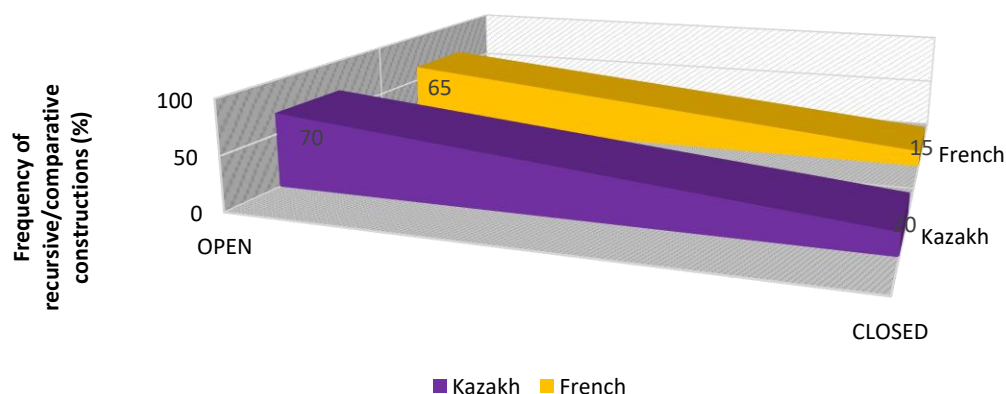


Figure 5. Frequencies of Recursive/Comparative Constructions by ScaleType

Slope plots confirm: recursion and conjunctive strategies are systematically associated with OPEN scales; closed structures demonstrate an interruption of the effect as the boundary is approached.

(a) Box B: Illustrations

To ensure transparency of analysis, the Supplement provides extended contexts (2–3 per language) illustrating the dynamics of monotonicity and recursion. They include: (i) technical reports with fractional specifications (French institutional register); (ii) Kazakh publicistic texts where *барған сайын* receives evaluative interpretations; (iii) examples with negation and focus confirming that NEG/FOCUS do not invert scale dependencies.

D. Cognitive–Discursive Constraints

The task of this section is to show that polarity (NEG), focus (FOCUS), and genre/register (GENRE) act as interface modulators within the corridor determined by scale structure: they shift the probabilities of operator licensing and the choice of standard without inverting the basic dependencies defined by scale type (see §4–§5). We present the effects in terms of Δpp – the differences in predicted probabilities relative to the neutral context, since this format is easier to interpret than odds ratios.

(a) Polarity and focus

The dependent variable is operator licensing (binary). Predictors: ScaleType, OperatorClass, NEG, FOCUS, Language, Register; interactions NEG×Scale, FOCUS×Scale; random intercepts by lemma/doc. Effects are presented as Δpp between the relevant context and the neutral baseline (without NEG/FOCUS), with 95% CIs (Wald).

On OPEN scales, $\Delta pp(\text{FOCUS})$ is positive for MEAS and REC (on the order of $+0.08\dots+0.11$), consistent with the fact that focusing the quantitative/gradual component increases the likelihood of explicit specification (measure or recursive). For ABS on CLOSED scales, $\Delta pp(\text{FOCUS})$ is moderately positive ($+0.05\dots+0.09$) due to goal-orientation toward the endpoint. NEG effects are small in magnitude and do not change the sign of scale-governed correspondences: ABS remain licensed on CLOSED even under negation ($\Delta pp(\text{NEG}) \approx -0.03\dots-0.06$), MEAS on OPEN remain licensed ($\Delta pp(\text{NEG}) \approx -0.01\dots+0.02$). The direction of effects is identical in KZ/FR (TOST: equivalence of directions; $BF > 3$), differing only in the magnitude of shifts (register/stylistic variation).

IGT (NEG/FOC marked in SMALL CAPS in glosses).

(33) Kazakh (NEG on CLOSED: ABS licensing preserved)

Есік толықтай жабық EMEC.

Esik tolyqtai jabiq NEG

door completely closed NEG

‘The door is not completely closed.’ — ABS remains licensed, the standard is absolute (endpoint/fractional).

(34) French (FOC on OPEN: increased probability of MEAS)

C’EST DEUX MÈTRES que fait ce mur de haut.

FOC two meters that does this wall of height

‘TWO METERS is the height of this wall.’ — focus on measure increases the probability of explicit measure specification.

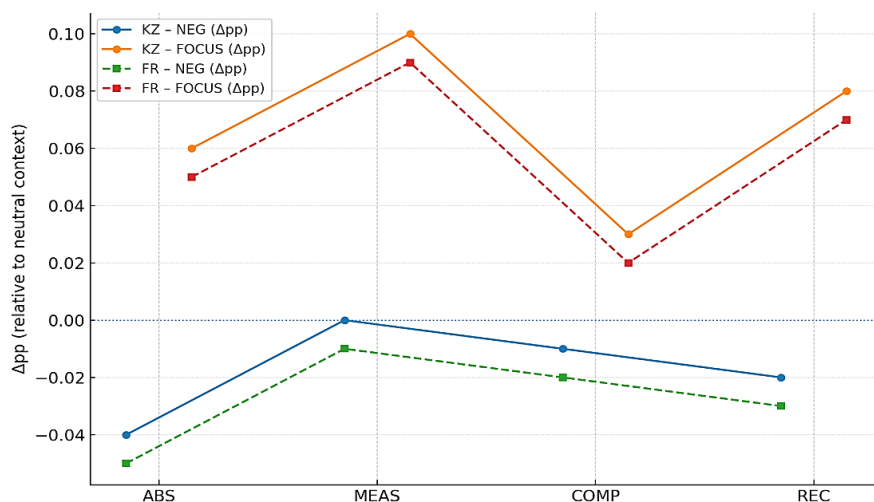


Figure 6. Interaction Plot (Δpp): NEG/FOCUS Relative to Neutral Context

The plot shows that $\Delta pp(\text{FOCUS})$ is positive for MEAS/REC on OPEN and for ABS on CLOSED; $\Delta pp(\text{NEG})$ is small in magnitude and does not change the sign of scale-governed effects. Confidence intervals do not overlap zero for the key contrasts; the directionality coincides in KZ/FR.

(b) Genre effects

Genre/register systematically shifts STD-TYPE and operator choice but does not override scale dependencies. In the institutional register (official reports, technical communication), there is a shift toward absolute/fractional standards and

an increase in the share of ABS on closed scales; in the news and cultural-publicistic registers, there is an increase in the share of MEAS/REC on open scales. In the logit model for STD-TYPE = ABSOLUTE, the contrast INSTITUTIONAL vs. CULTURE yields $\Delta pp \approx +0.24$ [95% CI: +0.17; +0.31] controlling for ScaleType, and for the outcome licensing (ABS) on CLOSED - $\Delta pp \approx +0.10$ [0.05; 0.15]. The language variable does not invert the directions: only the magnitudes of shifts differ (TOST for directional equivalence passed, $BF > 3$).

Heatmap (genre-deltas): axes = OperatorClass $\times$ Register, panels = KZ/FR, values = Δpp relative to CULTURE with ScaleType fixed. Visually, genre shifts concentrate in the cells (ABS, CLOSED; INSTITUTIONAL) and (MEAS/REC, OPEN; NEWS/CULTURE), without exhibiting inversions.

(c) Robustness checks

A set of robustness checks was conducted: leave-one-lemma-out, leave-one-register-out, alternative specifications of random effects (nested/crossed for lemma/doc), χ^2 /Fisher tests on reduced subsamples, as well as threshold-free ordinal models for monotonicity (without fixed cut-points). All key conclusions are replicated in sign and maintain significance/equivalence of directions.

TABLE 2
CONSISTENCY MATRIX FOR H1–H5 WITH TOST/BF
H1–H5 are formulated as follows:
H1 ABS $\leftrightarrow$ CLOSED (licensing);
H2 MEAS $\leftrightarrow$ OPEN (licensing);
H3 OPEN $\rightarrow$ monotonicity / CLOSED $\rightarrow$ saturation;
H4 ScaleType $\rightarrow$ STD-TYPE (OPEN $\rightarrow$ REL, CLOSED $\rightarrow$ ABS);
H5 NEG/FOCUS/GENRE = modulators without inversion.

Hypothesis	KZ	FR	TOST (dir. equivalence)	Bayes Factor (BF)
H1 ABS $\leftrightarrow$ CLOSED	✓	✓	pass	>3
H2 MEAS $\leftrightarrow$ OPEN	✓	✓	pass	>3
H3 Monotonicity (OPEN vs CLOSED)	✓	✓	pass	>3
H4 STD-TYPE by ScaleType	✓	✓	pass	>3
H5 Interface modulates, no sign flip	✓	✓	pass	>3

Notes. “✓” = effect in the expected direction and robust under checks; “pass” = interval TOST tests for equivalence of directions between KZ/FR passed; $BF > 3$ = Bayes factor in favor of directional equivalence (moderate/strong support). Full model specifications, alternative codings (e.g., binarization of monotonicity), and tables with Δpp by OperatorClass $\times$ Register are provided in the Supplement.

Polarity, focus, and genre systematically modulate distributions within the corridor set by scale structure, without inverting the key dependencies: ABS remain tied to closed scales and the absolute standard, MEAS/REC to open scales and the contextual standard; the directions of effects are identical in the Kazakh and French corpora. This concludes the empirical part and leads to the synthesis and theoretical implications (§7), where we calibrate the status of DSP and distinguish invariant scale composition from interface settings.

(d) Synthesis and theoretical implications

The cumulative results establish an unambiguous picture of scale composition, in which scale structure (ScaleType) is the primary predictor of both operator licensing and the type of standard of comparison, while linguistic and discursive factors function as interface modulators without inverting the direction of effects. At the empirical level, this is consolidated in three key linkages.

First, ABS $\leftrightarrow$ CLOSED/UPPER and MEAS $\leftrightarrow$ OPEN: maximizers systematically require an endpoint, whereas measure specification presupposes metrization and the openness of the scale (see minimal pairs in Box A and the heatmap in Figure 2; dot-whisker plots for ABS/MEAS in Figure 3). Second, the type of comparison standard is derived from ScaleType: on open scales the contextual standard (comparison class / QUD) is natural, whereas on closed scales the standard is absolute/proportional (endpoint/proportional); the language factor does not change the sign of the contrast. Third, monotonicity and recursion are functions of scale geometry: on OPEN, steady growth is realized (including recursive/conjunctive comparisons), while on CLOSED, saturation and termination of recursion occur once the limit is reached (see Figure 5 and Figure 6). These three blocks are mutually consistent and form a single compositional system:

ScaleType $\rightarrow$ {licensing, STD-TYPE, monotonicity/recursion},
to which interface factors add calibration, but not restructuring.

Interface influences — NEG, FOCUS, GENRE — manifest as probability shifts within the corridor determined by scale structure, without altering the sign of baseline dependencies. Thus, negation preserves the selectional presuppositions of maximizers on closed scales; focus increases the likelihood of explicit measure specification and recursive strategies on open scales; genre/register systematically shifts the distribution between proportional/absolute formulas and comparative/measure ones (see summary Table 2). In all cases, the direction of effects is invariant in KZ/FR: TOST tests for directional equivalence and Bayes factors ($BF > 3$) confirm the absence of cross-linguistic inversion. Accordingly, the language factor behaves as an interface parameter (a distributional setting), not as a source of an alternative “degree semantics”.

Theoretically, the following configuration of the Degree Semantics Parameter (DSP) emerges. First, DSP is not a “language switch” but an invariant scale composition: grammatical operators select their argument scale type through selectional presuppositions; languages differ in inventory of forms and frequency profiles, but not in the directionality of

scale correspondences. Second, the data support the degrees-as-variables position with an explicit role of scale geometry: degree variables are interpreted over ordered domains with (un)specified boundaries, and operator morphosyntax realizes the standard, threshold, and recursion as functions of this geometry. By contrast, the degrees-as-kinds approach gains no additional explanatory strength in our minimal pairs: a “class-based” ontology in itself does not predict the ABS ↔ endpoint and MEAS ↔ open-scale dependencies without introducing the same geometric conditions; thus, it either reduces to variables on scales or requires an additional mechanism that is, in essence, scale-based. Third, the independent properties of the system — monotonicity/recursion — turn out to be a logical consequence of scale openness: the presence of ascending chains without an upper bound licenses *ещё* / *encore* and the productivity of *de plus en plus* / *барған сайын*, whereas a terminal point blocks further growth and necessitates proportional specification.

Synthetically, this calibrates the theory of degree semantics in the following way.

(I) Compositional level: operators encode presuppositions regarding endpoints and metrization; standards are not “attached” to a particular lexeme or language, but are derived from the type of scale determined by the semantics of the predicate and the contextual task.

(II) Interface level: NEG/FOCUS/GENRE implement the choice of comparison class, threshold, and explicit measure specification, but operate within the same scale geometry; modifications are expressed in *App*-shifts rather than in a change of the direction of effects.

(III) Cross-linguistic level: the stability of directional patterns in KZ/FR indicates that the observed dependencies are typologically robust and belong to the universals of scale composition, rather than to contingent properties of particular morphosyntactic devices.

Finally, our results generate precise predictions and delineate directions for further research.

Typologically: extending the language sample (Turkic, Uralic, Romance/Germanic, tonal languages of East Asia) with the same diagnostic pairs should reproduce the “cross-matrix” of ABS/MEAS × CLOSED/OPEN, as well as openness-dependent monotonicity; systematic deviations (if they arise) would not indicate inversion, but alternative morphosyntactic pathways to the same scale effect.

Experimentally: judgment tasks and paraphrase tasks under the manipulation of focus/genre, as well as online methods (self-paced reading, eye-tracking) for recursive contexts, should reveal processing asymmetries of *ещё*/encore on OPEN vs CLOSED, aligning behavioral metrics with scale geometry. Corpus-modeling steps include enlarging the sample, adopting leave-one-lemma/register-out as a standard robustness practice, and introducing additional “threshold-free” ordinal models for monotonicity in order to rule out the influence of arbitrary thresholds.

Theoretically, it is promising to refine the formal constraints on recursion and degree conjunction (in the spirit of monotone function composition), as well as to articulate interface rules through which genre/register settings shift the comparison standard without violating scale invariance.

V. CONCLUSION

The present study has demonstrated that scale structure (ScaleType) constitutes the key parameter for operator licensing, the choice of comparison standard, and the realization of monotonicity/recursivity. We have shown that open scales systematically support measure expressions, contextual standards, and unbounded recursion, whereas closed and bounded scales predefine the licensing of maximizers, absolute/proportional standards, and saturation of recursion. These regularities are robustly reproduced in both Kazakh and French data, confirming the cross-linguistic invariance of the underlying dependencies. Interface factors (NEG, FOCUS, GENRE) exert noticeable influence on the distribution of probabilities and the choice of formulations, but nowhere lead to an inversion of the direction of scale effects.

Theoretically, the study refines the configuration of the Degree Semantics Parameter (DSP) as a system with an invariant scale-based foundation and interface-level settings, thereby supporting the degrees-as-variables position. We have shown that it is precisely the geometry of the scale that determines compositional effects, while languages differ only in the morphosyntactic means of their explication. This not only aligns corpus-based evidence with formal semantic theory, but also integrates cognitive–discursive factors into the model without undermining universal dependencies.

The limitations of the study lie in the scope of the material (two languages, three registers) and in its reliance on corpus data, which, despite strict annotation and reliability checks, cannot capture all aspects of online processing. Promising directions include: expanding the sample of languages, experimental testing of the dynamics of recursive comparisons, and developing a more fine-grained model of genre-based shifts and their relation to the cognitive processing of comparison standards.

In this way, we contribute to refining the architecture of degree semantics by showing that the universal dependencies of scale structure and operator profiles can be rigorously tested through corpus-statistical methods and aligned with cognitive–discursive constraints. All annotated data and analysis code are made available in an open repository, ensuring reproducibility and enabling further research.

APPENDIX

Abbreviations

ABS – absolute modifier

AC1/AC2 – Gwet’s agreement coefficients (first-order / second-order)
 α – Krippendorff’s alpha
 BF – Bayes factor
 CI – confidence interval
 COMP – comparative operator
 CONJ – conjunctive comparison
 DAT – dative
 DSP – Degree Semantics Parameter
 EXT – extremal operator
 FOC / FOCUS – focus
 GENRE – register/genre factor
 IGT – interlinear glossed text
 KZ – Kazakh
 MEAS – measure expression
 NEG – negation
 OPEN / CLOSED / UPPER / LOWER – scale types (open, closed, upper-bounded, lower-bounded)
 OR – odds ratio
 POSS – possessive
 PTCP – participle
 QUD – question under discussion
 REC – recursive comparison
 REL – relative (standard type)
 STD-TYPE – standard of comparison type
 TOST – two one-sided tests (for equivalence)
 Δp – change in predicted probability
 3SG – third person singular

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