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A Research Report on the Fifth Dimension of the SCFNT System: “Texture / Moisture–Dryness”

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Research Article

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Abstract

Objective: To test whether, without using laboratory component measurements, “texture / moisture–dryness” can be established—using traditional, documented macroscopic observable conditions of Chinese medicine—as a fifth dimension that is scorable, reproducible and independent of the existing four axes, and to measure how its explanatory power changes when it enters formula–syndrome matching. Methods: For 158 herbs, non-functional signs—habitat, medicinal part, body and cross-section, water test and decoction—were encoded into R (moisture–dryness, five levels) and T (lightness–heaviness, three levels). H1 uses the pharmacopoeia-based functions and indications as the criterion, while the official category at the formula level is a formula therapeutic-method classification. Evaluation used leave-one-out cross-validation, paired bootstrap, coding-rule-variant consistency (Cohen/Fleiss κ), 2×2 contingency tables (phi coefficient) and a transparent simplified ranking model. Results: On the 19 unambiguous criterion herbs, H1 passed (leave-one-out accuracy 100%, +36.8 percentage points over baseline, interval excluding 0). After adding R=0 neutral herbs and fluid-generating, clear-dispersing boundary herbs, the three-class leave-one-out accuracy fell to 84.8% (baseline 48.5%, interval [72.7%, 97.0%]); ablation showed R-only at 78.8%, T-only at 57.6%, and three-class logistic regression at 54.5%, while the binary hard comparison was 95.7%. H4 coding consistency passed (pairwise Cohen κ 0.812–0.947, Fleiss κ 0.858, exact agreement 86.7%). The continuous Spearman correlations of R with cold–heat and ascent–descent were −0.165 (p≈0.01, weak but significant) and +0.073 (not significant), respectively; the phi coefficients for the 2×2 tables were −0.111 and −0.053, neither significant. No H2 category-level gain was observed on the proxy model (point estimate negative, interval containing 0); H3 is treated as a descriptive observation only. Conclusion: The fifth dimension can be reliably annotated and is non-redundant, but its incremental predictive gain is not established; T is better understood as a derived label, and texture as a whole is retained for now as a descriptive, secondary axis, pending recomputation on the original pipeline and independent human re-evaluation before any decision to enter the main distance function.

1 Research Questions and Methodological Constraints

1.1 Three Sequential Questions

This project answers three threshold questions in sequence. First, can texture and moisture–dryness move from rhetoric to a scorable scale, so that different judges, without reading the function records, give close scores for the same herb? Second, is this scale truly independent of the existing four axes—cold–heat, ascent–descent, deficiency–excess and meridian tropism—rather than another way of stating ascent–descent? Third, does its addition bring a measurable gain in explanatory power without disrupting the already-frozen conclusions at the method layer? If the first question fails, the other two are moot; if the third fails, the proper course is a graceful withdrawal rather than forcing the dimension in.

1.2 Continuity of Approach: Macroscopic Observable Conditions in Place of Component Measurements

This study does not use component indicators that require instrumental decomposition, such as polysaccharide fraction, volatile oils or tannins. Measurable conditions are here reconceived as non-functional observable conditions: the water endowment of the habitat, the medicinal part, body and tactile feel, cross-section, water test (sinking/floating, swelling, slimy stringing, water staining) and the clarity or thickness of the decoction—all directly observable at the desk by the senses, without instruments or component decomposition, and independent of “what the herb treats”. This is continuous with the system’s longstanding method of understanding medicinal properties through habitat. Chemical components remain only an optional, after-the-fact external corroboration; they do not enter the scoring and do not establish a component-determines-property causality. The input uses only the [characteristics], while the [functions and indications] serve solely as the criterion, so as to prevent information leakage.

2 Coding Scheme and Data

2.1 Two Descriptors and Their Positioning

Two descriptors are recorded separately at the coding stage: R (moisture–dryness, governing dispersing and conserving, five levels − 2 to + 2) and T (lightness–heaviness/thickness, three levels light, medium, heavy). The levels of R are defined by signs such as dry-and-fibrous body, farinaceous (starchy) quality, horny texture, richness in oil, gumminess and the clarity or thickness of the decoction; T is defined by aromatic flowers and leaves, roots/stems/fruits, and minerals and shells. It should be noted that T is determined mainly by the material weight of the medicinal part and is structurally correlated with cold–heat and ascent–descent; it is therefore better understood as a derived label summarizing material weight rather than an independent measurement axis parallel to R. R is the principal descriptor carrying the independent information of this dimension.

2.2 Annotation of the 158 Herbs: Criteria and Confidence

All 158 herbs were annotated one by one, each attached to at least one observable sign, with the criterion type, evidence source and confidence filled in. The criterion type was entered according to the principal criterion: cases involving stickiness on immersion, a thick decoction, gumminess on chewing, or a viscous nature are based mainly on the water test and decoction; heavy, sinking minerals and shells are based mainly on the medicinal part; the rest are based on characteristics such as body and cross-section, farinaceous-fibrous quality, and moist, oil-rich texture. The final distribution is shown in the table below.

Axis / item	Level distribution
R moisture–dryness	−2: 2; −1: 76; 0: 55; +1: 23; +2: 2
T lightness–heaviness	light: 26; medium: 108; heavy: 24
Criterion type	characteristics: 131; medicinal part: 21; water test & decoction: 6
Confidence	high: 70; medium: 88; low: 0

2.3 Correction of the Formula-Level Convention (Restoring 246)

An earlier script, due to an off-by-one error at the last row, omitted Qianjing Fuzi Tang, so that it was missing from the formula texture table and all statistics. It has been added in this version, restoring the formula level to 246 rows. After checking the composition, Qianjing Fuzi Tang and Fuzi Tang were confirmed to have exactly the same composition and doses (Aconite, Poria, Ginseng, Atractylodes, Paeonia) and to be the same formula under different names; their R_cand and T_cand are the same as those of Fuzi Tang (− 0.282, 1.000), and the profile values use the same source data. Thus, among the 246 formula names, 245 are compositionally independent; subsequent statistics are all recomputed on the 246 convention.

3 Test Results

3.1 H1: “Same Cold, Different Uses” Are Separable (19-Herb Criterion, Pass)

The 19 criterion herbs (12 clear-and-dispersing, 7 yin-nourishing-and-conserving, including five deficiency-heat-clearing anchor herbs outside the 158) were used for leave-one-out cross-validation using only R and T. The majority-class baseline was 63.2%; the nearest-centroid (R + T) accuracy was 100%, R-only was 94.7%, and logistic regression was 94.7%; the balanced accuracy was 100%, + 36.8 percentage points over baseline, and the bootstrap 95% interval [10.5, 47.4] excludes 0, meeting the pre-registered success line. This criterion set is clear and unambiguous but selected; it demonstrates that the dimension carries a genuine signal and does not represent universal performance across the whole domain.

3.2 H1 Extended Validation: The Real Discrimination After Adding Neutral and Boundary Herbs

To test whether the high accuracy came from sample selection, 10 R = 0 neutral herbs (Zhi Gancao, Fuling, Huangqi, Shanyao, Chaihu, Gegen, Yiyiren, Jiegeng, Zhishi, Fangfeng) and 4 fluid-generating, clear-dispersing boundary herbs (Zhimu, Tianhuafen, Lugen, Zhuye) were added; all labels were given independently from the function-based convention, giving 33 herbs in three classes. The nearest-centroid

leave-one-out accuracy was 84.8%, the majority-class baseline was 48.5%, and the bootstrap 95% interval was [72.7%, 97.0%]. The confusion matrix is shown below.

True dispersing	Predicted dispersing	Predicted neutral	Predicted conserving
	12	**3**	**1**
True neutral	0	10	0
True conserving	0	1	6

The errors were concentrated at explainable boundaries: Zhimu (R = 1 but clear-dispersing in function) was misclassified as conserving; Tianhuafen, Lugen and Yinchaihu (R = 0) were misclassified as neutral; Biejia (a shell, R = 0) was misclassified as neutral. The neutral class was correct in 10/10, and the neutral labels are defined independently by function-based criteria (without referencing R). In the ablation, the R-only three-class accuracy was 78.8% and T-only was 57.6% (only slightly above the majority-class baseline of 48.5%); the three-class logistic regression was 54.5%. When only the dispersing/conserving binary hard comparison was performed (23 herbs, including the 4 boundary herbs), the accuracy was 95.7%, with only Zhimu misclassified. This set of comparisons shows that the independent information is carried mainly by the level boundaries of R, while T contributes little; a linear decision boundary can hardly cut out the middle class in the R/T space, so the conclusion relies on a distance-based (nearest-centroid) method and linear extrapolation requires caution. Zhimu is the explicit counterexample of where R goes wrong (see Discussion).

3.3 H4 Coding Consistency (Pass, Rule-Variant Convention)

Sixty herbs were sampled by stratified sampling across the five R levels and annotated separately under the same SOP by three coding-rule variants: baseline A, conservative B (extreme levels merged), and boundary variant C (high-confidence items fixed; medium-confidence boundary herbs take an adjacent level with 25% probability, with a fixed random seed and the assumptions recorded explicitly). It must be emphasized that this is the reproducibility of the coding rules and is not called “expert validation / expert consensus”; independent human re-evaluation is the ultimate form of H4.

Indicator	Value
Cohen κ (baseline A vs conservative B)	0.947
Cohen κ (baseline A vs boundary variant C)	0.815
Cohen κ (conservative B vs boundary variant C)	0.812
Fleiss κ (three variants)	0.858
Exact agreement across the three variants	86.7%

3.4 Independence: 2×2 Contingency Tables and the Phi Coefficient

At the 246-formula level, the continuous Spearman correlations of the dose-weighted R_cand with cold–heat netP and ascent–descent sP were − 0.165 (n = 246, t ≈ − 2.61, p ≈ 0.010, weak but significant, explaining about 2.7% of variance) and + 0.073 (p ≈ 0.26, not significant), respectively. To test independence under the classified convention, 2×2 contingency tables were constructed according to whether R is positive and whether the corresponding axis is positive; the phi coefficient and Pearson's chi-squared without continuity correction were calculated (the minimum expected frequency in both tables exceeds 5), with the results in the two tables below.

R × ascent–descent sP	sP > 0 ascending	sP ≤ 0 non-ascending	Total
R > 0 moist	12	22	34
R ≤ 0 dry	91	121	212
Total	103	143	246

φ=−0.053, χ^2=0.701 (uncorrected), p = 0.402, Fisher's exact test p = 0.457; R and ascent–descent are nearly orthogonal.

R × cold–heat netP	netP > 0 hot	netP ≤ 0 non-hot	Total
R > 0 moist	16	18	34
R ≤ 0 dry	133	79	212
Total	149	97	246

φ=−0.111, χ^2=3.015 (uncorrected), p = 0.083, Fisher's exact test p = 0.091; under the classified convention, R and cold–heat show only a weak negative co-occurrence (moist formulas tend slightly toward the non-hot). Both tables have |φ| below 0.13 and are not significant under the classified convention, supporting that the information carried by R is not substituted by the existing axes; the weak significant correlation in the continuous convention (above) is consistent in direction with this phi and corroborates it. The 9 formulas with R = 0 are classified as non-moist into R ≤ 0.

3.5 H2 Syndrome-Level Category Gain (No Gain Observed)

Because the meridian coverage, the cosine of the function vectors and the 128 case-syndrome coordinates of the original frozen pipeline are not in the current file, a transparent simplified ranking model was built (normalized cold–heat axis difference + ascent–descent axis difference + λ·texture axis difference, with the formula correction states taking − H and − Q), comparing λ = 0 with the pre-registered initial value λ = 0.3 on 19 standard syndrome patterns. The Top-5 official-category hit changed from 0.368 to 0.316, a difference of − 5.3 percentage points, with the paired bootstrap 95% interval [− 0.263,

0.105] containing 0; the Top-1 hit of 0.211 was unchanged. The pre-registered H2 requirement of “≥+6 percentage points with the interval excluding 0” was not met, and the point estimate is negative in direction; it is therefore recorded honestly as no gain observed, rather than the vaguely worded “not confirmed”. This is a result based on a proxy model and is not a formal falsification: the formal adjudication requires the original pipeline and the 128 case-syndrome coordinates.

3.6 H3 Changes in the First-Choice Formula (Descriptive Observation)

Under the same model, the texture term changed the first-choice formula in 9 of the 19 syndromes, with the direction-layer category changing in 3 of them; the direction-layer hit changed from 0.737 to 0.895 (difference + 15.8 percentage points, interval [0.000, 0.368], with the lower limit exactly 0). Given that the lower interval limit is 0 and the model is a proxy, this result is treated only as a descriptive observation and is not stated as a validated gain; the already-frozen direction coordinates themselves were not altered.

4 Counterexamples and Discussion

Counterexample 1 (supplementing herbs are not moist): The mean R_cand of the 13 supplementing-category formulas is only + 0.071, close to neutral, rather than the intuitive “supplementing means cloying and moist”. This shows that texture does not simply follow the supplementing function; it both supports the independence of texture and indicates that supplementing herbs cannot be blanket-labeled as “moist”. The genuinely moist ones are the few among them that are gummy and oil-rich (such as Ejiao, Jizihuang and Danggui).

Counterexample 2 (the boundary of fluid-generating and clear-dispersing): Zhimu has R = 1 but its function is to clear heat and drain fire, while Tianhuafen and Lugen have R = 0 yet can generate fluids; both show that “generating fluids” is not the same as “conserving and filling”. R/T going wrong at these boundaries is precisely the applicability boundary and should be made explicit in interpretation rather than avoided.

On the positioning of T: The Spearman correlations of T_cand with netP and sP reach − 0.482 and − 0.558, markedly stronger than those of R, because T is derived from the material weight of the medicinal part and overlaps with the structural design of cold–heat and ascent–descent. T therefore should not be claimed as an independent axis with incremental value; it should be positioned as a derived label, with the independent information carried mainly by R.

Applicability boundaries (distributions of T_cand and R_cand): T_cand ranges from 0.05 to 2.00 with a mean of 0.926, and about 59% (146/246) fall between 0.75 and 1.25; the material weight at the formula level is concentrated around “medium”, with limited discrimination, and it does not participate in subsequent distance calculations. The effective variation of R_cand is concentrated on the dry side: only 12 formulas have R > 0.5 and 105 have R < − 0.5, so the dimension’s characterization of the “moist” side

is not yet established, and conclusions involving moist formulas have only descriptive value in this small sample. At the 158-herb level, 55 herbs (about 35%) have R = 0, all with medium confidence and mostly sharing standardized sign descriptions; they belong to the middle level of “no clear cloying or dryness observed”. The stability of this level awaits independent human re-evaluation, and this study does not let it bear weight as a validated middle category.

5 Overall Judgment and Positioning

The current answers to the three questions are: it is scorable and reproducible (H1 including the extended validation and ablation, H4 passed); it is independent of the four axes and non-redundant (in the continuous convention weak but significant with cold–heat, not significant with ascent–descent, while the phi coefficients are not significant under the classified convention); but the incremental predictive gain is not established (H2 no gain), and the frozen layer was not disrupted (H3 descriptive only). Accordingly, texture / moisture–dryness is for now best retained as a descriptive, secondary axis. R is used to characterize structural features such as the temporal side of formulas—“moving quickly, staying long”—and the mouthfeel and the populations they suit, while T serves as the derived label of their material weight; neither enters the main distance function immediately. At the dietary-nourishment product level, it may serve as a reference for formulation and labeling, without involving efficacy claims.

6 Limitations and Future Work

First, H2 is a result of a simplified proxy model with only 19 syndromes and wide intervals; the formal test must be conducted after the syndrome coordinates of the original frozen pipeline, the 128 cases and internal cases can be recomputed, and should follow the pre-registered success line without post-hoc parameter tuning.

Second, H4 is rule-variant consistency, and re-evaluation by an independent human annotator is still missing; until conditions allow, it is uniformly described externally as coding consistency rather than expert reliability.

Third, the upstream cold–heat netP is a legacy column: the same formula under different names, Fuzi Tang and Qianjing Fuzi Tang, take different values while netA/netB are consistent; the cold–heat convention is based on netA/netB. The R/T of this study does not rely on the netP construction.

Fourth, this study conducts no wet experiments, collects no new samples and cites no undisclosed data; all annotations can be checked at the desk. Counterexamples and items to be verified are retained, and no unsupported causal or efficacy inferences are made.

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Supplementary Files

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- SCFNTTextureMoistureDrynessWorkbook.xlsx