

House of Mirrors: Monotone Nonlinear Transformations for Modeling and Quantifying Perceptual Distortion in Data-Driven and Psychometric Systems

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INTRODUCTION & AIM

Modern AI, psychometric, and social media systems often process information through nonlinear transformations. Although order may be preserved, perception can become distorted, creating a **“House of Mirrors”** effect.

This research models perception as a nonlinear transformation. $Y = h(X)$

- X : underlying truth
- h : nonlinear perception function
- Y : observed perception

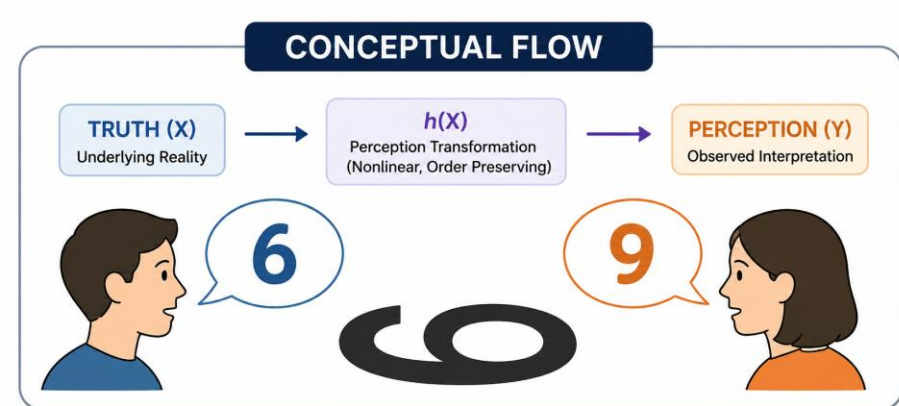


Fig. 1. Same truth, different perceptions.

This creates a **“House of Mirrors”** effect:

Same underlying truth can produce different perceived realities under nonlinear transformations.

Aim of This Study

Develop a mathematical framework to quantify perceptual distortion using:

- Truth Drift (TD)
- Differential Entropy Difference (DED)
- Confidence Distortion Index (CDI)
- Kullback-Leibler divergence

METHOD

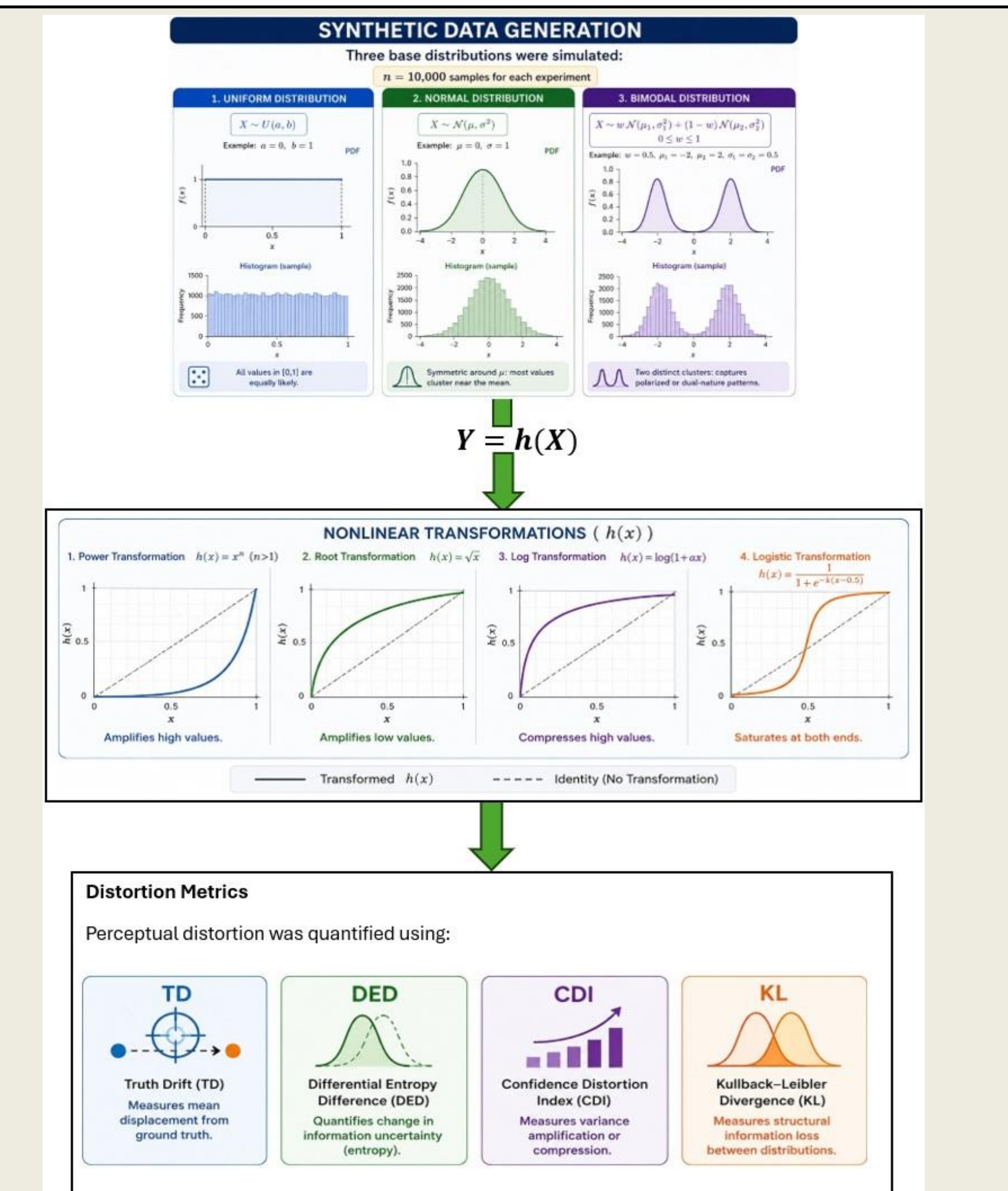
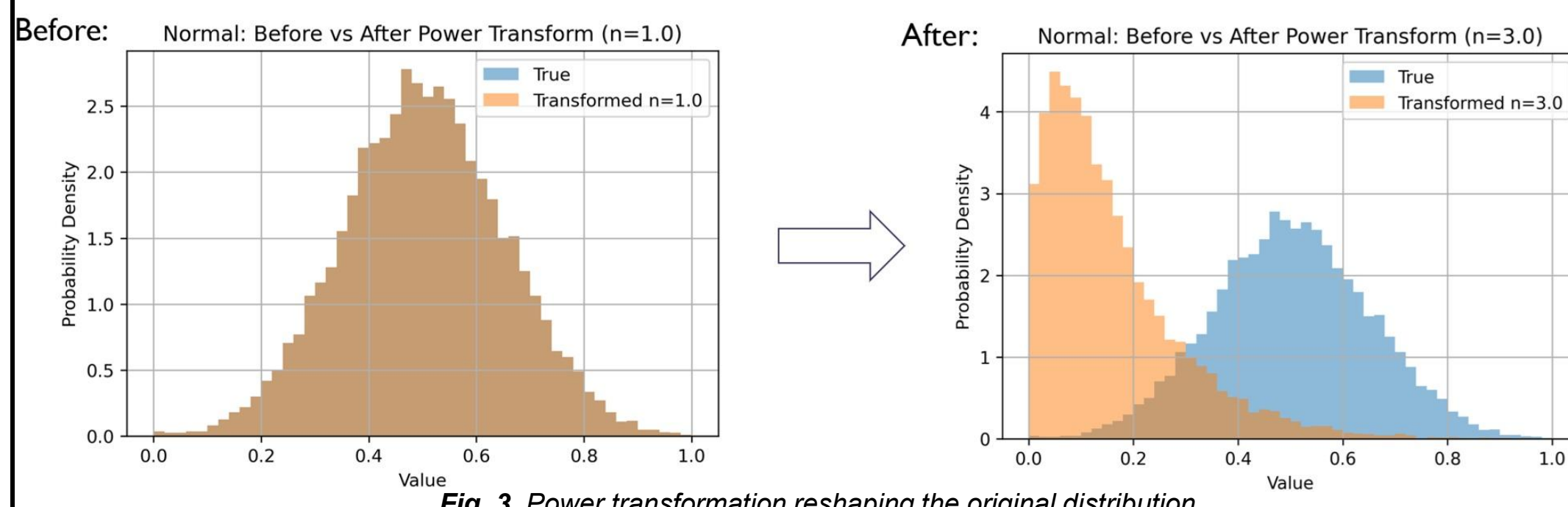


Fig. 2. Methodological framework for modeling perceptual distortion using nonlinear transformations and information-based metrics.

RESULTS & DISCUSSION

Distribution Distortion Under Nonlinear Transformation



- Higher transformation curvature produced stronger perceptual distortion.
- Order was preserved, but information structure changed significantly.

Transformation Behavior

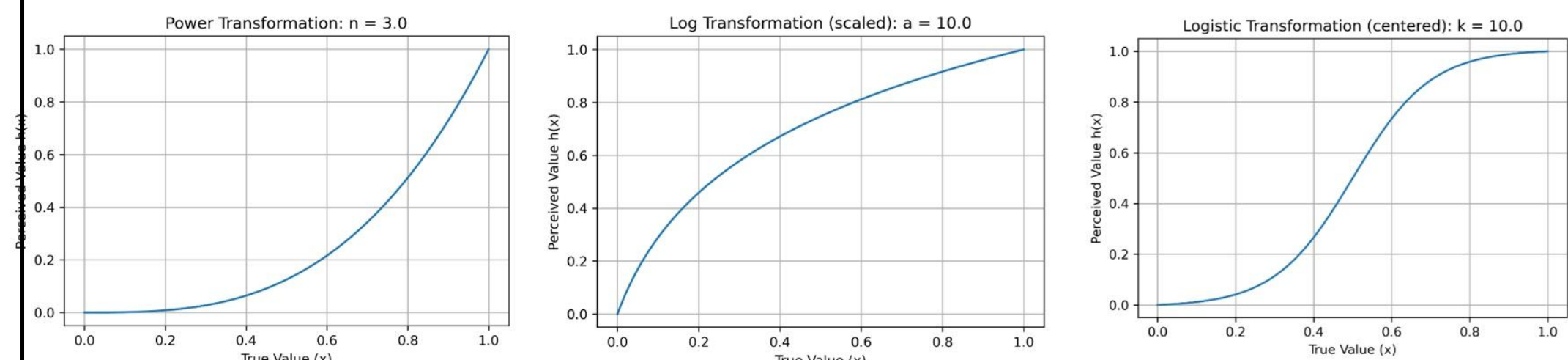


Fig. 4. Effects of power, logarithmic, and logistic transformations.

Power → amplification Log → compression Logistic → polarization

Distribution Distortion

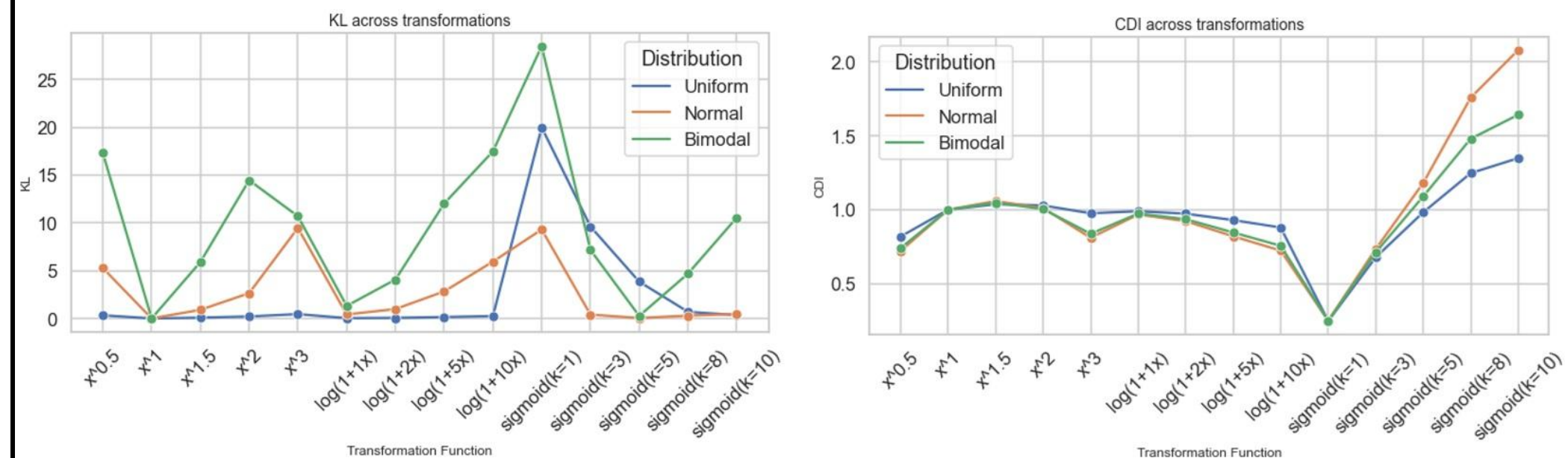


Fig. 5. Distribution distortion induced by a monotone nonlinear transformation.

KL Divergence Summary

Distribution	KL Divergence
Uniform	2.573
Normal	2.781
Bimodal	9.594

Table 1. Summary of KL Divergence Results.

Higher KL divergence indicates stronger structural distortion.

CONCLUSION

- Nonlinear transformations introduced measurable distortion.
- Bimodal systems showed the strongest information divergence.
- Order preservation does not guarantee informational neutrality.

Nonlinear transformations preserve order while reshaping confidence, uncertainty, and perceived truth.

FUTURE WORK / REFERENCES

- Apply framework to real-world AI and recommendation systems.
- Develop visualization tools for distortion-aware algorithms.

The authors declare no conflicts of interest.

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