In a previous paper (Gorur-Shandilya et al 2017), we showed that \textit{Drosophila} olfactory receptor neurons (ORNs) that express the co-receptor Orco scale their gain inversely with mean odor intensity, according to Weber-Fechner’s law. Here we investigate the implications of this front-end mechanism for odor coding capacity in natural environments, where the intensity and timescales of odor signals can span several orders of magnitude, and odors can mix together. We find that ORN adaptation promotes the reconstruction of odor identity from dynamic odor signals, even in the presence of confounding background odors and rapid intensity fluctuations. These enhancements are further aided by known downstream transformations in the antennal lobe and mushroom body. Our results, which are applicable to various odor classification and reconstruction schemes, stem from the fact that ORN adaptation is not intrinsic to the identity of the receptor involved. Instead, a feedback mechanism adjusts receptor sensitivity based on the activity of the olfactory receptor Orco complex, in accordance with the Weber-Fechner law. Hence, a common scaling of the gain with respect to odor intensity across Orco-expressing ORNs may be one of the features of ORN adaptation that helps preserve combinatorial coding of odors in naturalistic odor landscapes.

Our results, which are applicable to various odor classification and reconstruction schemes, stem from the fact that adaptation depends on the activity of the the scaling of this adaptation is similar across all Orco-expressing ORNs

Thus, despite the broad overlap between individual ORN tuning curves, a mechanism of front-end adaptation, when endowed with Weber-Fechner scaling, may play a vital role in preserving representations of odor identity in naturalistic odor landscapes.

Our results, which are applicable to various odor classification and reconstruction schemes, stem from the fact that ORN adaptation is not intrinsic to the identity of the receptor involved. Instead it results from transduction downstream of olfactory ion channel activity, dynamically adjusting receptor sensitivity in accordance with the Weber-Fechner law.

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Instead a feedback mechanism, likely involving the universal co-receptor Orco, adjusts receptor sensitivity based on the activity of the olfactory receptor complex, in accordance with the Weber-Fechner law.

%Hence, the common scaling of the gain with respect to mean odor intensity across Orco-expressing ORNs might be one of the key features of ORN adaptation that enable the maintenance of the combinatorial coding in flying insects.