Evolution of olfactory coding in moths: different resolutions for different needs?

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We asked what impact phylogeny and life history have on the coding of odours in the brain. Moths are particularly suitable for this kind of investigation because they use olfactory cues to locate their host plants and because the moths' primary olfactory neuropil, the antennal lobe, is anatomically conserved. We visualized activity patterns in the antennal lobe evoked by ecologically relevant plant volatiles in three species of hawk moths (Sphingidae) and two species of owlet moths (Noctuidae) by *in vivo* functional imaging. We found that elementary features of olfactory coding have been conserved between the two families, separated for 65 million years. However, we also found family-specific differences: in noctuid moths, coding patterns were specific even for structurally similar odorants, while in sphingid moths, the representation of most odorants was less distinct. This variation probably reflects the different weight these families give to olfactory versus other, e.g. visual cues. The three tested sphingid species, all with particular life histories, still had almost identical coding patterns. Therefore, diverging life histories influence the insects' olfactory system on a large evolutionary timescale, while closely related species whose ecological needs differ apply similar olfactory coding strategies, indicating a slow evolutionary adaptation process.