Stereotypy and diversity in the morphology of axon terminals of the perforant pathway and of intrinsic projections of the denteate gyrus and medial entorhinal cortex of albin swiss mice

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Behavioral, electrophysiological, and anatomical assays in rodents have shown substantial evidence that the medial entorhinal cortex hippocampus and dentate gyrus are essential for spatial memory consolidation. In mice, there are no detailed anatomical investigations of axon terminals into these regions to complement those assays. The aim of the present work is to identify and reconstruct axon terminals of intrinsic connections of the Dentate Gyrus (DG) and Medial Entorhinal Area (MEA) as well as of the MEA perforant pathway of the adult albin Swiss mice, using biotinylated dextran amine (BDA). Four individuals were injected with BDA by iontophoresis into the granular and molecular layers of DG and MEA. Quantitative 3-D analysis was performed with automatic microscopy and software Neurolucida 5.0.1 (Microbrightfield Inc.). Thirty axonal fragments with multiple branches and 53 with single branches, restrict to the DG granular layer, were submitted to cluster and discriminant analysis. Two main types of axon intrinsic terminals were found and designated Type I and Type II. Multiple branching terminals, after similar analysis were also grouped in two main types. Type I presented higher planar angle (38.73; ±4.60) than type II (25.20; ± 2.91), ANOVA, Tukey, p = 0.022. Type II presented higher boutons density (62.46 boutons.mm^{-1}; ±4.11) than type I (17.13 boutons.mm^{-1}; ± 3.33), ANOVA, Tukey, p = 0.0001. Single terminals were distinguished by boutons and type II presented a higher density of boutons (103.61 boutons.mm^{-1}; ± 3.66) than type I (39.39 boutons.mm^{-1}; ± 3.67), ANOVA, Tukey p = 0.0001. Fifty five fragments of intrinsic terminals of the medial entorhinal cortex and 39 from the perforant extrinsic terminals also presented two basic types of fragments after cluster and discriminant analysis. Type II of intrinsic terminals presented higher boutons density (90.36 boutons.mm^{-1}; ± 6.79) than type I (12.26 boutons.mm^{-1}; ±1.88), ANOVA, Tukey p = 0,0001. Type II of the perforant pathway also present higher boutons density (150.07 boutons.mm^{-1}; ± 12.60) than type I (17.19 boutons.mm^{-1}; ± 3.45), ANOVA, Tukey p = 0.0001. Comparative analysis indicates that there is a common principle of organization for different neuroanatomical regions with high level of stereotypy and some diversity in DG and MEA. Taken together the results anticipate the possibility that neuronal network connections into those regions could be constructed with similar morphological strategies that would be replicated in different dimensions.

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