Foraging Efficiency and Learning in Capuchin Monkeys (*Cebus capucinus*)

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Primates have relatively large brain to body ratios and spend a substantial period of their life in the juvenile development stage. Large brains suggest long juvenile stage, hypothesizing that primates require long juvenile periods to learn complicated foraging techniques. Critics of this hypotheses argue that foraging efficiency increases primarily as a function of increased muscle mass, not learning. We set out to determine if the juvenile period is in fact used to learn complicated foraging techniques by examining food preferencing behavior in white faced capuchin monkeys (*Cebus capuchinus*). Individuals of varying ages were observed as they selected fruits from attalea palm trees (*attalea butyracea*). Learning was tested by counting the number of times each individual touched, bit, or dropped individual fruits before eating them. We found that individuals tested fruits less as they aged, indicating that individuals learned how to distinguish a desirable fruit from a non-desirable fruit over time. These results support the previously stated hypothesis and justify the long juvenile period in primates, offering insight to the evolutionary drivers of primate ecology.

Creating a Statistically Characterized Reference Data Set to Test 2D Image Registration Algorithms for Testing Automated Portal Alignment for Patient Set-Up

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Create and characterize a reference data set for testing image registration algorithms that transform megavoltage portal image (MVPI) to digitally reconstructed radiograph (DRR), which will be used in future, studies to test automated portal alignment for patient set-up. Six orthogonal images set anterior/posterior (AP) and lateral (LAT) of head and neck, abdomen and pelvis were selected. Computer assisted manual point selection tool (CAMPST), devoted software created in-house, was used to manually select landmark point pairs by an expert. 58 anatomic landmark points were manually paired between the six images for AP and 52 for the LAT. Approximation of inter- and -intra observer variation was determined by repeat measurement on both images by three other readers as a 2D Euclidean distance. The hypothesis that the mean difference between intra and inter observer registration error equal some critical value between 1mm and 7mm using the test statistic for paired data was tested. The registration error was generally high for the MVPI than the DRR due to the inherent poor quality of images acquired using megavoltage energies. Also, the inter observer error was higher than the intra-observer error which is to be expected, as it is more likely for an individual to repeat their own point rather than someone else. The lower limit of the 95% confidence level was higher than 1mm and the upper limit higher 7mm. Our results agree with what has been reported in literature that the accuracies of 2D and 3D registration method fall between 1mm to 7mm.

Identifying Optimal Panobinostat Treatment Regimens Utilizing Reverse-Engineered Concentration-Time Curves

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The Ex Vivo Mathematical Malignancy Advisor Model (EMMA) is a support tool for treating Multiple Myeloma. A biopsy is taken, and patient plasma cells are cultured in plates to which chemotherapies are applied. These plates are imaged, and an algorithm produces a cell viability curve for each plate. EMMA is fit to these curves and parameterizes patient-specific models of chemosensitivity to each tested chemotherapy. For EMMA to predict patient response to a specific chemotherapy, the model must incorporate that chemotherapy's concentration-time curves (CTCs). These describe the average temporal variation in concentration doses of a specified chemotherapy will undergo in humans. Because CTCs aren't readily accessible to the public, a novel mathematical model was formulated to reconstruct the CTCs of orally-administered Panobinostat. Model parameters were fit by minimizing the residual between the 20mg model curve's c_{max}, t_{max}, and AUC_{inf} metrics, from those publicly provided about Panobinostat's 20mg CTC. For the reconstructed CTCs of different doses, the model was solved using a different dosage value, and c_{max}, t_{max}, and AUC_{inf} were checked to ensure they fell within the reported range. Model CTCs were coupled to create alternative treatment schedules. Using each logged patient's chemosensitivity model, alternative treatment schedules were substituted, and EMMA was run to produce best response: the predicted largest percent reduction in tumor volume that patient will experience. For 51.4% of patients, treatment scheduling produced best response metrics varied such that they were not all >50% or <5%. This indicates for half of patients, Panobinostat scheduling can be optimized.