# ELECTRONIC NEWSLETTER ON REASONING ABOUT ACTIONS AND CHANGE

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## Today

Last December, Graham White sent us a set of questions to John McCarthy and Tom Costello for their article "Useful Counterfactuals". At that point the article had already been accepted for the ETAI, but as usual that is by no means a reason for stopping the discussion. John McCarthy's answer follows in this Newsletter. - Please refer to the ETAI webpage in order to also see the original questions, and the earlier discussion between Pearl and McCarthy re this article.

## ETAI Publications

### Open discussion

### Useful Counterfactuals

by **Tom Costello and John McCarthy**

Comment from: **John McCarthy**

Because of the length of Graham White's comments on our "Useful Counterfactuals", we decided to summarize those aspects of his questions for which we have possibly interesting answers.

1. White asks about the applicability of Cartesian counterfactuals to celestial mechanics. As we said in the paper and as White expounds, one can take the initial phase space co-ordinates (positions and velocities) of the planets together with time. Counterfactuals can be formulated in terms of varying these co-ordinates. I don't see that our theory has much to add in this case. White goes on to ask about integrals of the motion, pointing out that there aren't enough to make a co-ordinate systems when there are more than two bodies. Nevertheless, it may be possible to formulate some interesting counterfactuals in terms of approximate integrals of the motion. Thus we may ask, "Would the solar system be unstable if Jupiter had 50 percent more angular momentum?, and there may be some sense in which this question can be answered.

2a. White asks if our theory has a semantics in Quine's sense. We haven't looked. In particular, we haven't looked at conditions of identity.

3a. White asks about invariance under co-ordinate transformations. Many common sense theories are effectively invariant under time translations, e.g.

the effects of actions in blocks world theories don't depend on when the action was performed. Some common sense theories also have some kinds of spatial invariance. In common sense theories of trading, total money may be conserved and in common sense physics, total mass is conserved. Nothing as high-powered as Noether's theorem is involved. Maybe a Hamiltonian is required for that.

Almost no common sense reasoning involves invariance under change to a relatively moving co-ordinate system, first of all because many common sense thories don't use co-ordinate systems in which relative motion is formulatable. Moreover, common sense physics gives the local earth a privileged position, since lots of the objects aren't systematically moving relative to one another. Invariance of physical laws relative to such transformations was the big discovery of Galileo and Newton.

3b. White asks whether changes of vocabulary to make reasoning more convenient are allowed. Yes.

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