

Judea Pearl Meets Yakir Aharonov in Wheeler’s Delayed-Choice Experiment

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We organize a framework that makes Judea Pearl’s causal-inference vocabulary operational for Wheeler’s delayed-choice experiments, and that uses weak values to quantify counterfactual attribution to intermediate measurements that are not actually performed. We model Wheeler-type delayed choice as an intervention $do(S = s)$ on a late setting variable S , and show that the interventional quantity $P(Y|do(S = s))$ is a forward-causal estimand that is identifiable from observed data via the back-door criterion under standard randomization assumptions. Apparent retrocausal narratives are reinterpreted as selection (collider or d-speration) bias induced by post-selection. We further interpret weak values for intermediate alternatives as conditional quasi-probabilities.

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