OBSERVER INFLUENCE ON QUANTUM INTERFERENCE: TESTING THE VON NEUMANN–WIGNER CONSCIOUSNESS-COLLAPSE THEORY

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Background: The von Neumann–Wigner consciousness-collapse interpretation of quantum mechanics was explored by testing whether human observation of a spot of light caused by photon interference in a diffraction-grating optical interferometer might act as a weak quantum measurement effect.

Aims: The preregistered prediction was that illumination recorded in a portion of the interference pattern would be reduced when a feedback signal based on that measure was observed versus unobserved by human participants. Another portion of the interference pattern was recorded simultaneously but not observed to provide control data.

Methods: Forty-seven participants were selected via a worldwide search for individuals with experience in focusing their attention. Each was provided with a custom-made optical apparatus. They ran a preassigned series of test sessions to test if illumination recorded in a portion of the interference pattern would be affected when a feedback signal based on that measure was observed versus unobserved. Multiple environmental sensors in each interferometer were employed to confirm the integrity of the optical signals.

Results: With all data combined the results did not support three formal preregistered hypotheses, but an exploratory analysis cited in the preregistration showed that participants selected for experience with an outward focus of attention significantly reduced illumination using the preregistered method of analysis ($p < 0.008$). A post hoc analysis also found a progressive decline in illumination while participants observed a portion of the interference pattern, as compared to data recorded simultaneously from an unobserved portion ($p < 10^{-13}$). Applying the same analysis during no-observation periods found no difference ($p < 0.77$), and control data run without observers present also resulted in nonsignificant effects.

Conclusions: This study justified a more detailed follow-up study exploring the consciousness-collapse hypothesis with a diffraction-based optical system.

Keywords: Observer effects, Consciousness-collapse interpretation, Optical interferometry

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