Conflict and interaction uncertainty: two applications in the field

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The shift from individual to group member creates a fundamental measurement problem between the conjugate variables of observation and action that we link mathematically to quantum physics by noting that the measurement of one precludes a simultaneous measurement of the other (Bohr, 1966). This measurement bistability can generate incommensurable world views that gives rise to conflict, which produces social evolution by solving problems (increasing adaptability from decreasing entropy production and increasing energy availability).

But cooperation among groups is considered to produce more effective problem solvers possibly by reducing intergroup bias (Bettencourt et al., 1992). Cooperation supposedly produces the greatest social good (e.g., Axlerod, 1984), which is believed to be social creativity. The National Academy of Sciences (NAS, 1994) believes that cooperation in building a consensus is critical to restoring trust in the Department of Energy (DOE). The Keystone Center in Colorado, an organization devoted to solving environmental problems at DOE sites, awards individuals "who demonstrate outstanding leadership through consensus building". In contrast, Friedman (1982, p. 109) considers competition to be the better social good. Janis (1971) believed that cooperation produced inferior solutions. Conflict theorists agree (e.g., Simmel, 1955).

A field experiment illustrates action-observation complementarity. 125 USAF fighter pilots flew eight 3-min flight-simulator encounters against computer and human opponents. Knowledge of air-to-air combat was determined by an examination weighted to favor expertise. Experience summed flight-time and training history. Based on multiple regressions, experience significantly predicted win-loss outcomes ($R=.34$, $p<.03$), total aircraft energy-availability scores relative to opponents ($R=.37$, $p<.01$, and an expert-rating of performance ($R=.47$, $p<.0001$). However, expert knowledge did not predict win-loss outcomes, energy scores, or expert ratings (in all three conditions, $R=0.0$, p n.s.). These results have ramifications for the limitations or applications of knowledge: as uncertainty in action is reduced to zero, uncertainty in observation or knowledge increases without bound.

To apply complementarity in the field, independent scientific peer reviews (ISPR) were used to create tension (conflict) to decrease observational certainty among scientists at DOE Savannah River Site (SRS; in Aiken, SC) to improve their practices of science. That ISPR reviews were enacted at SRS after recommendations by the SRS Citizens Advisory Board but not by the Board at DOE Hanford (Richland, WA) offered a comparison between the two Boards and two sites that command the largest percentage of DOE's environmental budget. The SRS Board reaches its decisions by majority vote, the Hanford Board by consensus (see Lawless & Castelao, forthcoming).

From the survey data, compared to Hanford, the SRS Board reported that it invites more expert advice ($t(113)=1.1$, p n.s.), supports DOE's decisions ($t(115)=3.8$, $p< .003$) and actions more ($t(112)=5.6$, $p<.000$), that its trust in DOE is more positive ($t(115)=2.9$, $p<.001$), but that its members have less respect for the viewpoints of others ($t(114)=-2.2$, $p<.03$), achieve fewer consensuses ($t(114)= -2.4$, $p< .002$), trust in each other less ($t(112)=-1.7$, p n.s.), and like each other less ($t(113)=-0.5$, p n.s.).

Further, significantly more progress has occurred in the field at SRS than Hanford. Among its recent successes, SRS has closed two of its 51 high-level wastes tanks (HLW wastes are derived from the chemical reprocessing of fissile material), the first closures in the U.S. and possibly the world; and SRS has begun to vitrify in a glass melt poured into stainless steel canisters the HLW removed from its tanks (over 500 canisters by 1/1/1999), achieving another first in the U.S. In comparison to SRS, Hanford may not close one of its high-level waste tanks or begin to vitrify its HLW for another decade. Its poor field performance has been reviewed by a Congressional investigation which concluded: "The Hanford cleanup is the largest civil works project in history...[but] very little actual cleanup has occurred." (Blush & Heitman, 1996,

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