Brunswik's Influence on Geographic Profiling Research

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We decided to remain consistent with the structure of articles in previous Brunswik Society Newsletters by providing a summary of our research on a police decision-making task known as *geographic profiling*. This task requires a person to make a prediction about the location of an offender's residence based on information about where that offender committed his or her crimes. While we have yet to directly investigate whether or not probabilistic regularities govern the mechanism people use to perform this task, our investigations have been heavily influenced by Brunswik's philosophy of psychological research. We explain below how Brunswik's thinking has influenced our approach to studying consequential real life problems.

Perhaps the largest influence that Brunswik has had on our research is to enforce the importance of designing experiments that carry meaning beyond the laboratory. In that vein, we have aimed to ensure that our research is of importance for both public safety and policy issues and that our experimental results are generalisable to future investigative settings. This has required that we embrace Brunswik's notion of representative design, since offenders' actions are inevitably the consequence of complex, random interactions with the environment. Specifically, in our experiments, we have exposed participants to stimuli that is randomly sampled from large databases of actual serial offender information rather than artificially designed or selected. In measuring responses, we have similarly tried to limit the extent we constrain participants responses, often asking for free-response explanations of how they are tackling the task.

While we did not explicitly use Brunswik's Lens Model as a framework for our manuscript, a second impact of his thinking has been to provide a useful structure for considering the link between the cognitive strategies used by our participants (i.e., organism) and the patterns of offender spatial behaviour (i.e., environment). For example, in one study we tested the functional achievement (i.e., accuracy) of 215 participants on a task that required them to predict the residential locations of 10 randomly sampled serial offenders before and after being introduced to some cognitive strategies. Recognising the importance of introducing strategies that match the empirical regularities found in offender spatial behaviour, we introduced two strategies: the Decay strategy, which predicts that many serial offenders live close to their crime locations, and the Circle strategy, which predicts that many offenders live within a circle with its diameter defined by the distance between the offender's two furthermost crime locations. The Decay strategy matches the long-established finding that offenders do not travel far from their home to offend and that the frequency of offending follows an inverted "J" distribution (i.e., there are many more targets selected closer to, rather than further from, an offender's home). The Circle strategy matches evidence showing that the majority (often over 80%) of violent serial offenders' homes are located within an area demarcated by their two most distant crimes.

Our aggregate-level analysis of this study showed that participants were significantly less accurate in their predictions compared to the prescribed actuarial technique. However, once participants were introduced to one of two decision-making strategies (Decay or Circle), there was a significant improvement in the accuracy of their predictions, to a point where post-training performance did not differ significantly from the predictions of the actuarial technique. Yet, this analysis is limited in its usefulness, since it gives us no clues as to whether or not all participants were able to utilise the strategies, nor whether or not these strategies were effective in every map. Thus, in true Brunswikian fashion, we turned to an idiographic analysis of performances. This analysis showed that half of our participants made accurate predictions before being provided with the strategies. By looking at the relationship between the cognitive strategies used by the participants (before training) and the regularities of the offenders spatial behaviour (e.g., how central the sampled offenders live in relation to where they select their targets), we found that higher levels of predictive accuracy was the result of a match between the cognition of participants and the structure of the decision environment. Such detailed findings are not commonplace to our literature.

Overall, Brunswik's emphasis on the necessity to conduct research that will be meaningful outside the laboratory, to consider the representativeness of ones experimental design, and to explore the relationship between an organism's behaviour and mental processes and the structure of the environment has proven invaluable in our research. We plan to continue exploiting Brunswik's ideas in future research looking at the geographic profiling task (and other forensic related decision-making tasks) and to contribute to his notion of probabilistic functionalism.

**The order of authors is not meaningful.*

Effects of Data Uncertainty in a Process Control Microworld

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The purpose of our Brunswik-related research is to investigate potential effects of sensor noise on the Ecological Interface Design (EID; Vicente and Rasmussen, 1992) framework. In particular, we want to understand how sensor noise will affect operators' control strategies and performance.

Modern process control plants incorporate several sensors that are installed at strategic locations throughout the system (Johnson, 1997). Despite the current state of technology in sensing devices, information transmitted by the instrumentation and control equipment is often noisy (Stein, 1969). Therefore, data about the state of world will be uncertain, potentially affecting both the display content and the ways operators will control the equipment.

When information about the world is inexact, operators may have to adjust their decision-making tactics to account for the uncertain data. Collecting and integrating data which reflect uncertainty (e.g. sensor noise) will require high cognitive demands. Moreover, since the data is in part unreliable, different strategies might have to be explored to control the system efficiently (Woods, 1988). Uncertainty can also affect decisions and actions made by operators since the data have the potential of losing their real meanings and more interpretation might be required (Finger & Bisantz, 2002). Based on these indications, there seems to be a connection between sensor noise and control strategies (i.e. the ability for operators to adapt to uncertainty in the environment).

To understand to effect of sensor noise on operators' control strategies, a series of studies will be conducted on the DUal REservoir Simulation System II (DURESS II). Two different interfaces (P and P+F) for the same microworld were developed (Vicente & Rasmussen, 1990; Pawlak & Vicente, 1996). The P interface displays primarily physical information about the work domain. In contrast, the P+F interface (designed under EID principles) displays in a cognitive relevant manner both physical and functional information about the work domain by means of configural displays.

As the magnitude of sensor noise is increased on both displays, we expect performance to worsen and stability to decrease for both P+F and P operators, even though we anticipate that performance of P+F operators will not be inferior than that of P operators. Control strategies are also expected to change while operators learn how to cope with the noise, outlining aspects of adaptation to the uncertainty in the environment.

Our research is expected to contribute to the EID literature. It will be the first study to examine the impact of sensor noise on the robustness of EID by manipulating the magnitude of sensor noise. Moreover, it will also be the first study to address the issue of adaptation to uncertainty in the environment by manipulating sensor noise in a process control microworld.

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