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Postscript

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We briefly reply to the main points in White's (2005) and Luhmann and Ahn's (2005) *Postscripts*. Regarding the ingestion-of-medicine example, the prior knowledge that White uses about the other three cells in the contingency tables (see Figure 2 of our reply to the comments; Cheng & Novick, 2005) may not be apparent as input until one manipulates the outcomes in these cells. As our figure illustrates, different outcomes in these cells yield different causal conclusions. As for whether White's (2000) confounded results support his model of causes and enablers, a replication of the relevant condition without the problems noted earlier will provide the answer. Regarding the possibility of direct causal knowledge, causal inference involving haptic input will share a common core of constraints with causal inference involving other modalities—a core that includes regularity information. The immediacy and effortlessness of the perception of causality does not imply that no computation is involved, just as the immediacy and effortlessness of visual perception does not indicate that visual perception involves no computation, as any attempt to build a machine to perform those tasks will show.

Luhmann and Ahn's (2005) argument that q_{citrus}, the causal power of citrus fruit with respect to beetle repelling in our example, should be 0 despite q_{orange} being 1 is yet another demonstration of the incoherence of their framework. As they show in their Footnote 2, the value of 0 for q_{citrus} is what would be required for consistency between the two sides of their Equation 1 (from Cheng, 1997). But, $q_{\text{citrus}} = 0$ is incompatible with $q_{\text{orange}} = 1$ if oranges exist (as they do in our example), given the meaning of causal power. As noted earlier, q_x, the causal power of candidate cause *x* with respect to effect *e*, is defined as "the probability with which *x* produces *e* when *x* is present" (Cheng, 1997, p. 372). If oranges repel beetles, then when citrus fruits are present, the oranges among them repel beetles, and therefore citrus fruits evidently repel beetles with a nonzero probability. In summary, the 0 value that Luhmann and Ahn's framework requires for consistency in the equation is in fact logically impossible. Contrary to their argument, the value of 0.5 for q_{citrus} we used in our demonstration is not confounded. Our demonstration shows that if the values for q_{citrus} and q_{orange}, which are alternative hypotheses, are respectively obtained according to our theory, then treating alternative hypotheses as alternative causes would lead to counting the effect of the same token of the candidate cause multiple times (*e* due to orange O, a particular orange, as an orange and again as a citrus fruit).

Luhmann and Ahn (2005) argue for a framework of causal learning in which no causal learning can take place. They are unable to disagree with the resulting paralysis of causal inference noted earlier. They concur, for example, that the causal power of citrus peels in our beetle repellent example is unknowable by a reasoner unless he or she is omniscient. An overriding question is why their position would be worth considering. In keeping with their failure to treat causal learning as a problem to be solved, they argue for an answer that is not a solution to any problem.

The rest of Luhmann and Ahn's (2005) *Postscript* commits errors already noted earlier. First, they confuse the truth of a conclusion with the validity of an inference. They fault our theory for giving inaccurate causal powers when the proportion of oranges in citrus fruits varies across contexts. But, no theory of reasoning can guarantee true conclusions. The disconfirmation of a causal power inferred in a new context, rather than being detrimental to our theory, is in fact helpful to the construction of a more accurate picture of the causal world, as Cheng (2000) noted. In our example, if the reasoner notices that there is variation in q_{citrus} across contexts and that q_{citrus} correlates with the proportion of orange peels among citrus peels, a better hypothesis—"orange peels repel beetles"—may become apparent.

Second, Luhmann and Ahn assume that contexts carry labels. They dispute that Buehner, Cheng, and Clifford (2003) provided evidence in support of participants' willingness to generalize to nonlearning contexts. They object that Buehner et al.'s participants were "never asked 'about a new context . . . in which alternative causes [of headache, the effect in question] in the learning context were no longer present'" (p. 693) and that they could have interpreted the reduction of headaches in the new patients to be due to the absence of enabling conditions for headaches in these patients. In fact, both interpretations would have indicated a nonlearning context according to our definition of context (Cheng, 2000, p. 227), contrary to what Luhmann and Ahn suggest. Regardless, if participants indeed had had the "enabling conditions" interpretation, they would have answered that for the new patients, the estimated frequency of headaches if given a medicine, the candidate cause, is 0 for all problems (see Cheng, 2000). Instead, participants spontaneously gave a range of probabilistic causal judgments that systematically accord with simple causal power predictions (Cheng, 1997), indicating that they had in fact adopted the simpler "no alternative causes" interpretation.

Finally, although Luhmann and Ahn (2005) agree that their "confounding" by subset leads to paralysis, they attribute the problem to our theory "(or any other model that requires equally stringent assumptions)" (p. 692). The "stringent" assumption in question, however, is "no confounding," which is required by all measures discussed, including Pearl's (2000) probability of sufficiency. Clearly, what ought to be forsaken is not the usual no confounding requirement but Luhmann and Ahn's concept of "confounding" by a true cause that is a subset of one's candidate cause. It is interesting to note that untutored reasoners do not confuse alternative hypotheses with alternative causes. Whereas they would not conclude from the correlation between a drop in the barometric reading and the approach of storms that the drop causes a storm, they are untroubled by "confounding" by subset and would readily answer, for our example, that their best estimate is that citrus fruits would repel beetles probabilistically, in 5 out of 10 cases (cf. Buehner et al., 2003).

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