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Theory of Technology Dominance: Reflections on the Research to Date and the Mysteries Unexplored

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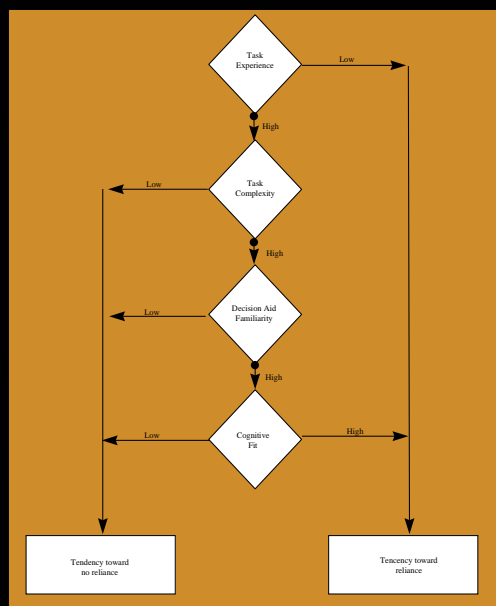
Foundations Underlying The Theory of Technology Dominance

- Why have intelligent decision aids had such limited success in the audit domain?
- How might intelligent decision aids be more effectively designed and used in the audit domain?

Arnold, V. and S.G. Sutton. "The Theory of Technology Dominance: Understanding The Impact Of Intelligent Decision Aids On Decision Makers' Judgments." *Advances in Accounting Behavioral Research*, Volume 1, 1998, pp. 175-194.

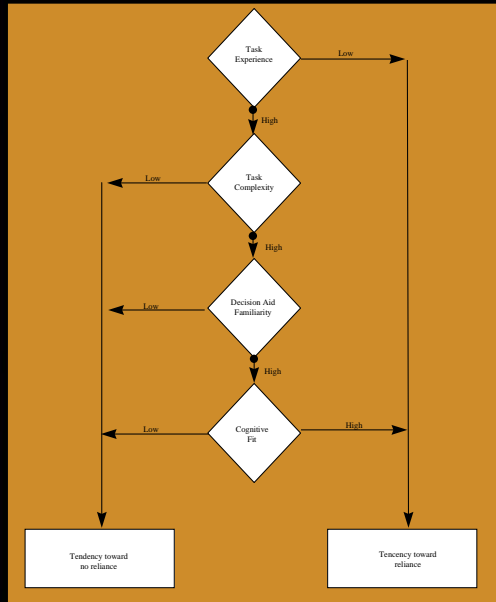
Three Parts to the Theory

- Factors that determine the likelihood that a decision maker will choose to rely on an available decision aid
- Conditions under which a decision maker using an intelligent decision aid is susceptible to dominance by the technology
- Long-term impact of intelligent decision aid use on de-skilling domain experts and impeding epistemological evolution



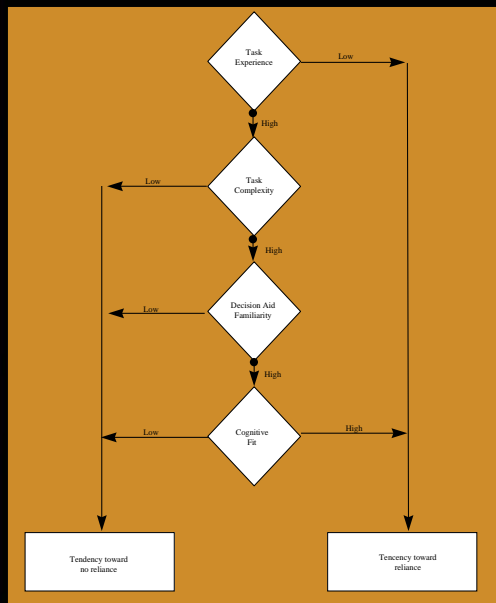
Reliance

- reliance = f (task experience, task complexity, decision aid familiarity, cognitive fit)



Experience

At low to moderate level of experience, there is a negative relationship between task experience and reliance on a decision aid

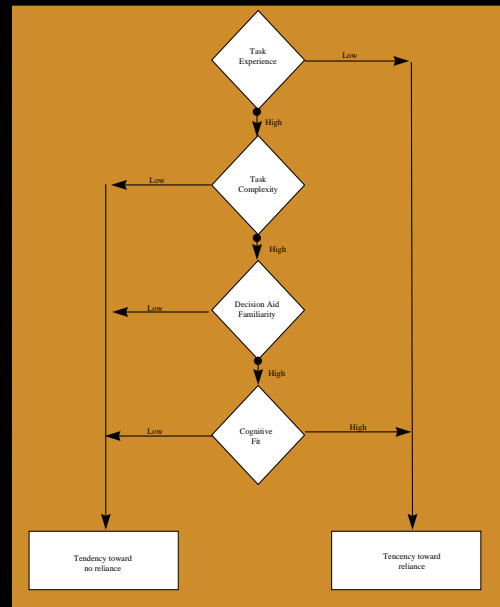


Task Complexity

positive relationship between task complexity and reliance on a decision aid

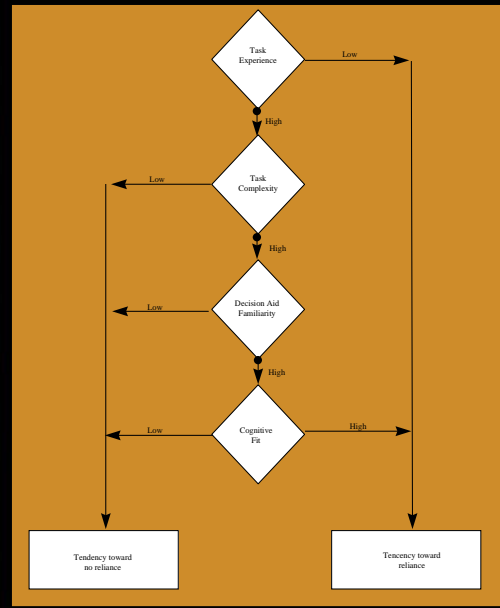
Decision Aid Familiarity

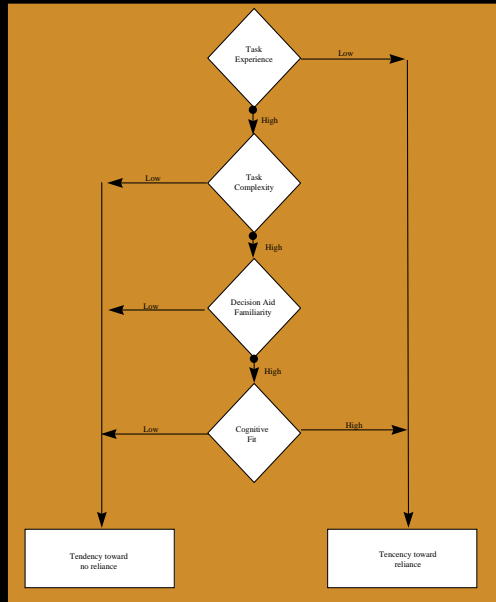
Positive relationship between decision aid familiarity and reliance on the decision aid



Cognitive Fit

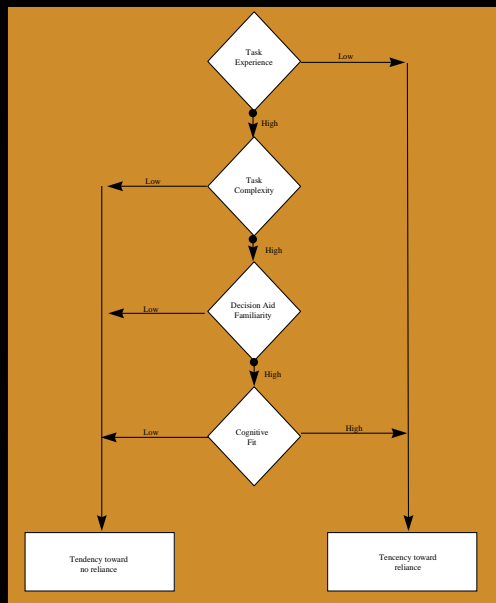
Positive relationship between cognitive fit and reliance on the decision aid





Reliance
 Experience (Y)
 Complexity (Y)
 Familiarity (N)
 Cognitive Fit (Y)
 Model (Y)

C. Hampton, 2006, "Determinants of reliance: An empirical test of the theory of technology dominance", *International Journal of Accounting Information Systems* 6(1).



Reliance
 Experience (Y)
 Complexity (Y)
 Familiarity (Ctrl)
 Cog. Fit (Ctrl)
 Incentives (-)

V. Arnold, J.E. Hunton, J. Reck, 2006, working paper, Bentley College.



Does the Reliance Model Hold?

- Questions in regard to familiarity—is it important in today's PC environment?
- Are there other factors that affect reliance? Probably!
- Caution: What is reliance?



Susceptibility To Dominance By The Technology

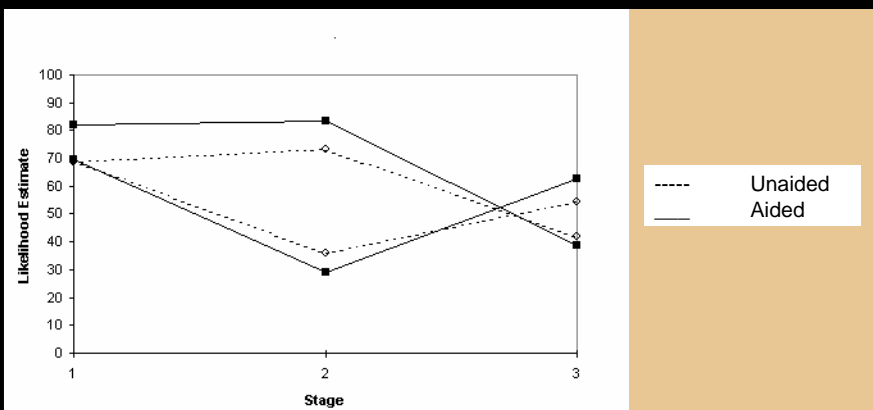
- Preliminary condition: Reliance
- When the expertise of the user and intelligent decision aid are mismatched, there is a negative relationship between the user's expertise level and the risk of poor decision making
- When the expertise level of the user and intelligent decision aid are matched, there is a positive relationship between reliance on the aid and improved decision making

Test with Novice/Expert Insolvency Practitioners

- Compared novice/expert insolvency practitioners level of bias susceptibility in manual vs. aided decision making.
- Found that the same aid increased novices bias, but decreased experts bias.

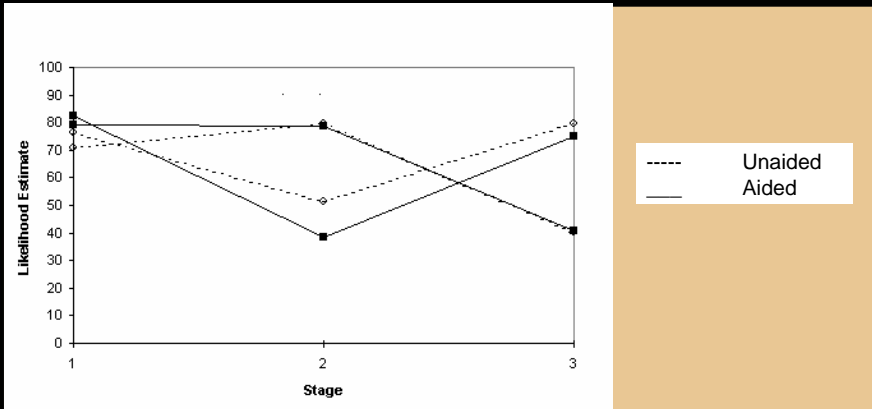
Arnold, V., P.A. Collier, S.A. Leech, and S.G. Sutton. "The Impact of Intelligent Decision Aids on Experienced and Novice Decision Makers' Judgments." *Accounting and Finance*, March 2004.

Test with Novice Insolvency Practitioners



Arnold, V., P.A. Collier, S.A. Leech, and S.G. Sutton. "The Impact of Intelligent Decision Aids on Experienced and Novice Decision Makers' Judgments." *Accounting and Finance*, March 2004.

Test with Expert Insolvency Practitioners



Arnold, V., P.A. Collier, S.A. Leech, and S.G. Sutton. "The Impact of Intelligent Decision Aids on Experienced and Novice Decision Makers' Judgments." *Accounting and Finance*, March 2004.

Test with Novice/Experienced Tax Preparers

- Use of tax compliance software has been assumed to improve the accuracy of taxpayers returns due to intelligent agents that identify errors, interpretations of tax laws, and possible IRS audit flags.
- Computer tax experiment showed novices substantially altering tax returns to overpay.
- Knowledgeable taxpayers generally ignored software warnings.

Masselli, J. R. Ricketts, V. Arnold, and S.G. Sutton. "The Impact of Embedded Intelligent Agents on Tax Compliance Decisions." *Journal of the American Tax Association*, Fall, 2002.



Related Test with Tax Preparers

- Less experienced users were not able to adequately use the TDSS and made inferior decisions when compared to more experienced users
- More experienced decision-makers using a TDSS made better decisions than their counterparts preparing a return manually.

T. Noga and V. Arnold. 2003. "Do tax decision support systems affect the accuracy of tax compliance decisions?" *International Journal of Accounting Information Systems* 3(2).



Problem w/o a Solution?

- Tests with real working intelligent decision support systems show the effect.
- What we don't know (and need to know) is why does the phenomenon occur (i.e. extend the theory) and can we solve it in design or through some intervention?



One Strategy at Alternative Design (Toulmin's Arguments)

- Provide different types of explanation facilities for different levels of decision makers
- Explanation types: definition, rule-trace, justify, strategic.
- Feedforward vs. Feedback
- Novices use more definitional, and more feedforward (Declarative knowledge)
- Experts use more non-definitional and feedback (Procedural knowledge)
- Experts that use procedural level knowledge explanations adhere more to the aid recommendation.

Arnold, V., N. Clark, P.A. Collier, S.A. Leech, and S.G. Sutton. 2006. The Differential Use and Effect of Knowledge-Based System Explanations in Novice and Expert Judgment Decisions *MIS Quarterly* 30(1)



Long-Term Effects of Dominance by Intelligent Technologies

- There is a positive relationship between continued use of an intelligent decision aid and the de-skilling of knowledge workers' abilities for the domain in which the aid is used
- There is a negative relationship between the broad-based, long term use of an intelligent decision aid in a given problem domain and the growth in knowledge and advancement of the domain



Test of Long-Term Effects

- Experiment required auditors experienced in the industry to list from memory 5 key business risks common to clients in that industry
- During the experiment auditors did not have access to a decision aid that is normally available from the firm during audits.
- Aids used by participating firms differ significantly in extent of decision support provided for the task.
- TTD #7 suggests level of support will negatively effect performance without the aid.
- As hypothesized, auditors from the firm with an aid providing a lower level of decision support listed more key risks than auditors from firms with aids having a high level of embedded decision support.

C. Dowling, S.A. Leech, R. Maroney. 2006. The deskilling of auditors' abilities: An empirical test of the theory of technology dominance. *2nd Asia-Pacific Research Symposium on Accounting Information Systems*.



We Need to Understand Epistemological Issues Better

- Is de-skilling wide-spread?
- Impact on epistemological growth?
- Who provides the domain expertise tomorrow?
- What interventions might solve this problem?*

*There is a big literature on learning from expert systems explanations and structuring explanations to transfer knowledge.



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