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A Cheater–Detection Module?

Dubious Interpretations of the Wason Selection Task and Logic

Abstract

People usually fail the WASON selection task, choosing P and Q cases, when attempting to validate descriptive rules having the form "If P, then Q". Yet they solve it, selecting P and not-Q cases, when validating deontic rules of the form "If P, then must Q". The field of evolutionary psychology has overwhelmingly interpreted deontic versions of the selection task in terms of a naturally-selected, domain-specific social-contract or cheating algorithm. This work has done much to promote evolutionary psychology as an alternative to a mindblind sociobiology that ignores the computational structure of cognitive mechanisms in producing people's behaviors. Nevertheless, evolution-minded researchers outside cognitive psychology know little of the ample literature challenging this interpretation and uncritically cite the 'cheater–detection module' as a key insight into human cognition. Although a priori arguments for a specially evolved cheater–detection module are plausible, the selection task provides no direct evidence for such a module.

Key words

Adaptation, cheater–detection, logic, modularity, relevance.

Introduction: Selecting Out Cheaters

Humans and other animals practice multiple forms of cooperation, or 'reciprocal altruism', among genetically unrelated individuals of the same species (TRIVERS 1971). One answer to why nonkin cooperate is derived from the concepts of 'trade' and 'tradeoff' in economics and game theory (AXELROD 1984, FRANK 1988). If the benefit of being assisted outweighs the cost of giving assistance, then individuals who practice mutual aid can outproduce others who don't. For example, vampire bats live in large, stable social groups and recognize one another by voice. To survive, vampire bats foray each night in search of a blood meal. Chances of success are highly variable and a bat will die if unfed for sixty hours. To reduce this variance and prevent starvation, bats with blood-filled stomachs will regurgitate some of this valuable and hard-to-get resource to other hungry bats. The best predictor of whether or not a bat will share with a needy nonrelative is whether or not the nonrelative has previously shared food (WILKINSON 1984).

Vampire bats may be able to recognize cheaters during grooming, when they can best perceive whose stomachs are most distended with food and yet are not sharing. It is unclear, however, whether a bat that fails to regurgitate is recognized as a 'cheater' only by individuals the bat has denied, or acquires a 'reputation' as a defector when other 'cooperators' observe the bat's denial to those in need. It is also unclear whether cooperation is a *quid pro quo* or "from each according to its ability", whether cheaters recognize the consequences of their 'defection', and whether cheaters or would-be cheaters learn from the 'punishments' meted out.

A group of individuals that always cooperated would not likely survive an invasion of cheaters, unless the cooperators could identify and exclude the cheaters. Otherwise, the cooperators would be in effect subsidizing cheaters at significant cost to themselves and thus driving themselves to extinction. A group of individuals that always cheated would not likely survive an invasion of cooperators that could reliably discriminate cooperators from cheaters, because cheaters would always be denied the resources that cooperators obtained from one another. Detecting cheaters usually carries some cost in time or energy allotted to marking, monitoring and punishing or defending against them. As a population tended to full cooperation, the (selection) pressures to pay the cost of detecting cheaters would lessen, but opportunities for cheaters to invade undetected would thereby increase. As cheaters began succeeding, cooperators would again have to evolve cheater–detectors or die out. These antagonistic selection pressures make it unlikely than any population involving interactions between nonkin would consist wholly of cooperators or cheaters.

In any event, cooperation could not work without a cognitive system that directs an organism's attention to information that could enable it to decide whether or not it was being cheated (COSMIDES/TOOBY 1992). In humans, the opportunities for cooperation and cheating can range over the exchange of virtually any material or intellectual commodity, including money, ideas, time and baseball cards. Consequently, a human cognitive system for detecting cheaters cannot be restricted to perceptions of food intake and outake, but requires a more abstract computational algorithm for representing the 'benefits' and 'costs' that accrue to the exchange of any 'good'. One such candidate algorithm for human cooperation takes the form: "If Party A takes some benefit from Party B, then Party A must pay back the cost to Party B". The corresponding algorithm for cheater–detection would be: "A benefitted from, but failed to pay the cost to, B".

A Modular Interpretation of the Selection Task

In 1966, Peter WASON introduced a selection task to study logical reasoning about conditionals that has become the most widely used instrument for the experimental exploration of the psychology of human reasoning. The task presents subjects with a conditional rule in either a descriptive form ("If an item has property *P*, then it has property *Q*") or a deontic form ("If an item has property *P*, then it should have property *Q*"). A paradigm example of the descriptive form is: "if there is a vowel on one side of the card, then there is an odd number on the other". Four double-sided cards are placed on a table so that the subject can see only one side of each card, such as 'A', 'B', '1' and '2'. The experimenter instructs the subject to indicate which of the four cards must be turned over to find out whether the rule is true or false. If the conditional rule is interpreted in terms of formal logic, then only the *P* card ('A') and the *not-Q* card ('2') need to be turned over. Nevertheless, WASON and numerous subsequent researchers found that, for such "abstract" versions of the descriptive form of the selection task, most subjects turn over the *P* card ('A') and the *Q* card ('1'). This seems to suggest that ordinary human inference does not generally obey the laws of propositional logic.

In deontological contexts that convey social obligation, however, studies show that subjects often perform 'logically'. For example, subjects are asked to imagine a policeman checking bars to see if bargoers obey the deontic conditional: "If you drink alcohol, then you must be over twenty-one years of age". Suppose the policeman reads the cards "Beer", 'Coke', '22 years', '16 years'. In these situations, most subjects choose the *P* card ("Beer") and the *not-Q* card ('16 years') (GRIGGS/COX 1982). To obtain a genuine deontic interpretation, the deontic rule has to make sense. A 'must' formulation is only suggestive, but neither necessary or sufficient.

In another deontic task, subjects are asked to imagine a worker who signs on with a firm under assurance that: "If an employee works on the weekend, then that person gets a day off". The subject is then asked to verify if the contract is upheld by selecting from the following cards: "Worked Weekend" (*P*), "Worked Only During Week" (*not-P*), "Got Day off" (*Q*), "Did Not Get Day Off" (*not-Q*). Most subjects 'correctly' pick the P and *not-Q* cards. But when asked to take the perspective of the employer, rather than the worker, most subjects pick the *not-P* and *Q* cards (COSMIDES 1989, GIGERENZER/HUG 1992, MANTKELOW/OVER 1991, POLITZER/NGUYEN-XUAN 1992, FIDDICK, COSMIDES/TOOBY 2000). It is counterintuitive to conclude that the only logical answers are those given from the worker's perspective and not the employer's perspective. Intuitively, both perspectives seem equally rational and reasonable.

These results have led some to surmise that deontic versions of the selection task differ from abstract descriptive versions by giving practical content to 'pragmatic schema', and that humans are naturally more attuned to reasoning with pragmatic schema than with abstract logic (CHENG/HOLYOAK/NISBETT/OLIVER 1986). According to Leda COSMIDES, however, 'content-effects' and 'pragmatic schema' are nebulous concepts that can arguably be reduced to a simple evolutionary imperative, "find the cheater". On her account, the deontic tasks are often naturally interpreted as social contracts. Verifying the violation of a social contract requires picking the 'benefit taken' and 'cost not paid' cards, whatever the logical form of the contract. For GIGERENZER/HUG (1992), even the notion of a social-contract algorithm is too broad; rather, their studies in perspective-shift suggest an evolved, domain-specific adaptation for a 'module' dedicated to discovery of cheating.

An Evolution-Sensitive Alternative

Perhaps the most forceful challenge to the selection task as evidence of a cheater–detection module comes from studies by SPERBER/CARA/GIROTTO (1995). Their proposal is that performance on *all* versions of the selection task—descriptive as well as deontic—can be readily explained by universal, cross-domain forms of reasoning that operate in conjunction with context-specific aspects of the task. These cross-domain processes are the same as those routinely used by all humans (excepting serious pathology) in ordinary linguistic communication (SPERBER/WILSON 1986). The general idea is that individuals attempt to ascertain the relevance of any new information within a context of pre-existing knowledge and expectancies (EVANS 1989).

SPERBER et al. experimentally manipulated the logical form, propositional content and pragmatic context of the selection task to test effects on judgments of relevance and card choice. If the new information, together with the background context, leads to new beliefs, or to rejection of old beliefs, then the information is relevant to that context. Subjects are intuitively confident in their spontaneous judgments of relevance and choose cards in conformity with those judgments.

Relevance is a matter of degree and involves cognitive tradeoffs. The greater the cognitive effects result form processing the information (e.g., the more the number of new beliefs or the wider the range of potential inferences), the greater the information's relevance to the individual; but the greater the cognitive effort needed to produce the effects (e.g., the more time it takes to process the information), the lesser its relevance on that occasion. For example, a student might be informed that: (1) classes start in early September, (2) classes start the morning after Labor Day, (3) classes start no more than thirty-six hours following the start of the last national holiday in summer. In most contexts, (2) is more relevant than one, because (2) implies (1) but not vice versa and so (2) has more associated inferences than (1). Statement (2) is also more relevant than (3) because it takes less time to process and understand (2), although (2) and (3) are inferentially equivalent. The resultant cognitive balance usually allows the communicator to formulate, and the auditor to comprehend whatever information the communicator's formulation is intended to convey, in a relatively rapid, economical and efficient way.

SPERBER et al. argue that subjects in the selection task behave no differently than people in ordinary communicative settings. Subjects attend to the most relevant information that is being made available to them by the experimenter, and attempt to interpret it within a context of assumptions that will maximize this relevance. When the experimenter presents subjects with the abstract version of the selection task, and a conditional of the form *If P then Q*, the first thing subjects try to do is simply find out whether or not there are relevant instances of *P* and *Q*. If there weren't, then the fact that the experimenter mentioned them at all would be an apparent violation of the tacit assumption that underlies all human communication: convey information in a relevant way. From a purely logical standpoint, subjects appear to be initially interpreting the experiment not as a problem of falsifying the universally quantified statement, "For all x ($Px \rightarrow Qx$)", but as verifying the existentially quantified statement, "There exists x (Px & Qx)". Moreover, if the subjects interpret the rule as applying only to the four cards in front of them, rather than to the task or cards in general, then subjects interpreting the conditional as an existentially quantified statement can falsify the rule just by turning over the *P* and *Q* cards in order to discomfirm that there is a *P* & *Q* card.

When the consequent is negated, however, the majority of subjects perform 'logically'. Take the statement: "If there is a vowel on one side of the card, then there is not an even number on the other side". Subjects pick the *P* card ('Vowel') and the *not-Q* card ('Even Number'). In general, when subjects are presented abstract versions of the selection task in the form *If P then Q*, "most subjects choose the matching cards *P* and *Q* and thus apparently solve the [logical] problem" (EVANS 1989, p57). SPERBER et al. argue that in such cases, subjects reconstruct the assumption that the rule denies, namely, that there are cases of *P* & *Q*: "This interpretation of the rule as a denial causes them to make the correct selection" (SPERBER et al. 1995, p79).

What is different about deontic contexts is that the pragmatic context shifts the emphasis from rule verification to rule violation. This creates a situation much like the negative-consequent version of the descriptive task, except that in deontic and thematic tasks, the content and the context—rather than any explicit negation in the consequent—indicate what assumption is being denied by the rule. For example, the fact that a person is over twenty-one years of age and drinks alcohol is not very informative to most people in our society. But the context (e.g., that there is a police officer checking) raises the possibility that there might be underage drinkers. In this context, underage drinking would have cognitive effects; therefore, it would be more relevant to interpret the information as *forbidding* underage drinking: not-(*Drinks Alcohol* & *not-Over 21*). In general, the logic form of subjects' interpretation of deontic versions of the selection tasks is: not-[There exists x (*P*x & *not*-*Q*x)].

Notice that the same logical interpretation could arise in contexts that do not involve social contracts or cheating detection. For example, take the statement: "If a person wins a professional boxing match, then that person must be sober". The prediction is that subjects would pick the *P* card ('Wins Match') and the *not*-*Q* card ('Drunk') because information concerning a winning but drunk professional boxer more likely has cognitive effects than information concerning a successful sober boxer" [***opening parenthesis?***] (cf. ALMOR/SLOMAN 1996).

FIDDICK/COSMIDES/TOOBY (2000) suggest that certain conditionals used in selection-task format might be interpreted in terms of a fitness-preserving hazardous-management module rather than a cheater–detection or social contract module. The general algorithm for a fitness-preserving conditional is: "If in a hazardous situation that is costly to fitness, then take the benefit of precaution". FIDDICK et al. predict (and experimentally confirm predictions) that the majority of subjects will pick the *P* ('Hazardous Situation') and *not*-*Q* ('No Precaution') cards.

FIDDICK et al. deny that relevance theory can reliably predict patterns of performance on deontic versions of the selection task, such as perspective shifts involving cheater–detection or fitness-preservation. For example, take the rule: "If you make poison darts, then you may use the rubber gloves". In the Privilege condition, subjects are primed to take the perspective of an anthropologist checking to see if tribespeople are abusing the privilege of wearing gloves. In this condition, subjects tend to make the apparently illogical *not-P* and *Q* selection. In the Risk condition, subjects take the perspective of an anthropologist checking if tribespeople are unduly risking their lives. In this condition, subjects make the logical *P* and *not*-*Q* selection.

Fiddick et al. argue that relevance theory must hold that either the rule is pragmatically awkward, or it is not. But if the rule is pragmatically awkward, then subjects should pick the illogical *not-P* and *Q* for both conditions. And if the rule is not pragmatically awkward, then subjects should pick the logical *P* and *not*-*Q* for both. In brief, relevance theory is seemingly faced with two contradictory outcomes: "because of its reliance upon logical formulae, relevance theory is placed in the unenviable position of having to invoke contradictory principles". As an alternative to relevance theory, FIDDICK et al. suggest that two different domain-specific schema are operating. In the Privilege condition, the anthropologist is using a *cheater–detection device* to see if tribespeople are abusing a privilege. In the Risk version, the anthropologist is using a *hazard-management device* to see if tribespeople are unduly risking their lives.

FIDDICK et al. fail to consider that, from the standpoint of relevance theory, both conditions may be taken as *implying* reciprocity:

A. Explicitly: For all x [*P(costly risk)* x → should take *Q (precautionary benefit)* x]

B. This implies: For all x [Q*(precautionary benefit)* x → should take *P(costly risk)* x]

In the Privilege condition, subjects look for a Violation of B:

Not-{there exists [*Q(Benefit)* x & *not-P(Cost)* x]}

In the Risk condition, subjects look for a Violation of A:

Not-{there exists [*P(Cost)* x & *not-Q(Benefit)* x]}

In another experiment, FIDDICK et al. present a bartering situation where people cannot *express* conditionals of the form "if P then Q". A farmer from one tribe nevertheless understands gestures from people in the other tribe indicating "We want potatoes" and he gestures back in ways that the people form the other tribe understand as "I want corn". The argument against relevance theory is that "I want P/ we want Q" does not work explicitly on logical form. Because relevance theory supposedly works only on logical form, relevance theory can't explain the results. But as FIDDICK et al. note themselves, surface form may differ from underlying logical form. Relevance theory makes no claim that surface form and logical form are isomorphic. Nor is such an isomorphism to be expected from the study of language. In syntactic theory, for instance, the command "Eat!", when understood as an imperative in English, entails two arguments that are absent in the statement's surface form but obligatorily present in its underlying logical form, namely, a subject and an object.

From the standpoint of relevance theory, the surface form of the barter, A, may be interpreted as implying the logical forms, B and C:

A. Explicit form: P (farmer give potatoes)/Q (tribe give corn)

B. Implicit form: For all x [*P(farmer's potatoes)* x → ought give *Q (tribe's corn)* x]

C. This further implies: For all x [*Q(tribe's corn)* x → ought give *P(farmer's potatoes)* x]

So, when asked to indicate when the farmer is cheating, subjects interpret this to mean that there is a Violation of C:

Not-{there exists [*Q(tribe gives)* x & *not-P(farmer gives)* x]}

When asked to indicate when other tribespeople are cheating there is a Violation of B:

Not-{there exists [*P(farmer gives)* x & *not-Q(tribe gives)* x]}

Leda COSMIDES and her colleagues are right to point out that interpretation of reasoning tasks involve various content-dependent algorithms that may have evolutionary import. As another example, consider the statement: "if a heavy object is projected up into the air up, then that object must come down". Arguably, subjects could invoke yet another domain-specific algorithm, a 'folkphysics module' (cf. SPELKE/PHILLIPS/WOODWARD 1995). It is unclear what module, if any, would cover selections for the following statement: "If a person wins a multimillion dollar lottery, then that person must be happy/sad". No cheating or hazard appears to be involved, although interpretation may involve evolution-linked affect schema.

A relevance-based interpretation of the WASON task does not require a strictly non-modular interpretation, such as interpretations that draw on mental-model theory or semantic networking. Neither does a relevance-based interpretation preclude the possibility of a cheater–detection module. Rather, the selection task evidence is simply better explained in terms of relevance than in terms of cheater detection. Relevance-guided comprehension may itself be evolutionarily specialized as a 'meta-representation module' (SPERBER 1994). But theoretical claims and empirical evidence for relevance-guided modularity are independent of claims about cheater–detection.

Logic: Another Dubious Cheater Catcher

In a recent essay, SPERBER (in press) turns the argument by COSMIDES and colleagues almost on its head. He proposes that some kind of argumentative logic is part of a naturally-selected adaptation that arose during an evolutionary arms race between communicators attempting to persuade (and deceive if need be) and audiences trying to evaluate messages as truthful or not. In the communication arms race, sophistry contributed as much as honesty to this adaptation for persuasion-and-coherence-checking. It is a nice a story, but so far *just* a story.

Historically, the formalization of deductive logic began with Aristotle, who sought an effective form of argumentation as a rhetorical device to parry the sophists and promote a better, scientific analysis of evidential relationships. The ensuing formalization was more than just a standardization of folk reasoning. It subtly but profoundly changed the use of everyday terms, such as 'if', 'and', 'or', and of words indicating inferential relationships, such as 'therefore', 'since', 'nonetheless'. In doing so it created counterintuitive truth tables for material implication. Thus, if the antecedent is false, the whole statement is true. Ordinarily, folk would probably conclude that the statement is indeterminate. True, if you put gold in aqua regia it either dissolves or doesn't (here folk intuition and formal logic agree). But if you don't put gold in aqua regia to begin with, then an ordinary intuition is that there's no argument possible. SPERBER points out (personal communication, 2001) that at least some cases of the antecedent being false and the whole statement being true seem to be amenable to ordinary intuition: for example, so-called Dutch conditionals ("If you're right, then I'm the Pope—or Dutch"). Nevertheless, logically, *all* such statements must be equally coherent—and they aren't.

Moreover, formal logic makes no distinction between ecologically valid and invalid reasoning. For example, the proposition "All ravens are black", has both an intuitive and formal relationship to evidence that bears on its truth, such as verifying that anything identified as a raven is indeed black. But the formally equivalent proposition, "All non-black things are non-ravens", has little pertinence for any real-world process of verification or evidentiary evaluation (if would be absurd and infinitely time consuming to actually go out and see if all things that are not black are indeed not ravens).

Finally, if logic is an adaptation for persuasion and cheater-detection, it's a pretty weak one. The advertising industry employs other types of reasoning and reflection on evidentiary relationships that side steps or easily overrides logic (e.g., you hair has protein, our shampoo has protein, therefore our shampoo is good for your hair). And, as Doug MEDIN notes (personal communication, 2001), perfume readily carries the day over argumentative displays of coherence, if circumstances are right, no matter how coherent the argument.

Conclusion: No Multiplication of Modules Beyond Evolutionary Necessity

If selection-task performance varies according to contexts that differentially draw upon existential verification, cheater detection, fitness preservation, folkphysics, affect programs or general encylopedic knowledge, then it is difficult to see how the selection task disambiguates or privileges any *particular* domain-specific mode of processing. The advantage of relevance theory over other accounts of the selection task is that relevance theory applies predictably to all versions of the selection task, without denying or privileging the effects of additional domain-specific competencies in any given context: "comprehension mechanisms and domain-specific mechanisms jointly contribute to subjects' performance, but… their effects are, as things stand, confounded" (SPERBER et al. 1995, p88).

The selection task mobilizes various information processing devices at the interface between our relevance-guided system of comprehension and any number of other task-specific modules. As our ability to identify modular systems becomes more secure, evidence of activity at the interface will undoubtedly add detail and refinement to our understanding of how modular mechanisms function and interact. But as with the interaction between the language faculty and various other cognitive systems, the interface is not the place to begin to understand modularity (CHOMSKY 2000).

Finally, the counter proposal that logic itself emerged as a module for coping with an evolutionary arms race between persuasion and cheater-detection also lacks independent support (say, of the kind that could be garnered for an emotion-based alternative). In general, I think that mental modules should be invoked as explanations only when independently converging arguments for modularity can be sustained. This could include evidence for: cross-cultural universality, early and rapid ontogenetic acquisition, ease and rapidity of cultural transmission, hyperactivity and difficulty in inhibiting operation even in the face of contrary instruction, selective cerebral localization or impairment, evolutionary analogies, functional phylogenetic homologies, imperfect but ecologically performative design (ATRAN 1998, 2001). These are not necessary and sufficient criteria for establishing modularity, only an imperfect but generally productive community of heuristics. This somewhat parallels the cautious strategy that George WILLIAMS (1966) introduced with respect to the concept of adaptation in evolution, and which has led to substantial progress in understanding evolutionary process and structure.

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