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Is Reasoning Culturally Transmitted?

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RESUMEN

De acuerdo con la explicación que ofrecen Mercier y Sperber, el razonamiento es una destreza que está primariamente diseñada par implicarnos argumentativamente con los demás, más bien que para la reflexión privada. Una afirmación estrechamente relacionada con la que no están comprometidos mantiene que el razonamiento podría ser "culturalmente transmitido": aprendido de los demás e incluso mejorado a lo largo de las generaciones. Argumento aquí que hay buenas razones para suponer que nuestras destrezas argumentativas son, al menos en parte, transmitidas de esta manera.

PALABRAS CLAVE: *razonamiento, Mercier, Sperber, transmisión cultural,* rachet *cultural.*

ABSTRACT

On Mercier and Sperber's account, reasoning is a skill that is designed primarily for engaging argumentatively with others, rather than for private reflection. A closely related claim that they do not commit to is that reasoning might be 'culturally transmitted': learned from others, and even improved over generations. I argue here that there are good grounds to suppose that our reasoning skills are indeed transmitted in this way, at least in part.

KEYWORDS: *Reasoning, Mercier, Sperber, Cultural Transmission, Cultural Ratchet.*

Suppose you decide one Friday after work that instead of going to your local bar for a beer, you'll try the bar up the road instead. You order a pint of Guinness. It doesn't taste as good as the pints in your local. The Guinness in this place is not as good as it is in your local, you conclude.

But is this conclusion warranted? You might have ignored the fact that there is a lot of variation in the quality of the pints in your local. That although the best stout you have ever had there tasted better than what you have just tried, you *have had* equally bad pints at your local. In fact, you have compared the pint you've just had in the new bar to the best pint you could remember from your local. You have fallen for the 'availability heuristic' [Schwartz et al. (1991)] – comparing the most

memorable of one sample (the best pint back you've had in your local) to the most memorable of another (the only pint you've had in the new place). Having this pointed out, perhaps by the statistician you're having a drink with, you realize that what you should really do is to compare how often you get a bad pint in the new bar to how often you get a bad pint in your local. If only 10% of the pints in your local taste bad, then you could only complain about the beer in this bar if a good deal more than 10% of it is bad. But how many need to be sampled to determine this? Perhaps if you try a second one, and this too is bad, that would do it. Indeed, it would seem to show that 100% of your sample is bad – far higher than the 10% back in your local. But of course, you still have no way of knowing whether you just happened to have hit two bad pints in a row in a bar that has, all things considered, exactly the same amount of good beer as your local. You might at this point find yourself unsure how to proceed.

Not to worry, your friend tells you: people have been developing techniques for reliably answering questions like this for a long time. To begin with you should not try to answer the question on the basis of your own quality judgments, because you are likely subjecting yourself to 'confirmation bias' – paying more attention to evidence that confirms your suspicion than to evidence that goes against it [Wason (1968)]. Rather, you should you find some people who don't know what you are trying to decide. Give each person one beer from each bar. Get these individuals to rate the quality of the pints on a scale of 1-10. Now you have two lists of numbers, and a prediction: that the ratings for the beers from your local should be higher than the ratings for the beers from the other bar, to a degree that we shouldn't expect from chance variation between the two sets of beer. You can check whether the ratings vary beyond what we should expect by chance using a paired 't-test', your friend tells you. She shows you how to carry it out, and tells you that if the resulting 'p-value' is less than .05, this means that you have reduced the probability that the difference between the samples is due to chance to just 5%, giving you a good reason to think that yes, indeed, the pints are better in your local. The test was invented, she adds, over 100 years ago by a statistician called William Sealy Gosset, working for Guinness [Student (1908)].

Something very interesting has taken place over the course of this short exchange at the bar. Your understanding of how to draw a reliable conclusion from a set of observations has been transformed from an intuitive and extremely misleading guess, to an extremely reliable procedure that will reduce the chances of your conclusion being false to 5%, and you have been steered away from several natural biases in reasoning at

the same time. All this due to a few minutes of interaction with a conspecific, using insights developed by another conspecific that lived several generations earlier. Among animal species, this kind of exchange is probably unique. Other species exchange information, for example by alerting one another to different kinds of predators [Zuberbuhler (2000)], some may teach each other how to hunt, or how to build tools [Musgrave et al. (2016), Moore (2013)], and may even pass such knowledge across generations [Gruber et al. (2009)]. But teaching one another how to think? This seems special.

Mercier and Sperber (M&S), in their book *The Enigma of Reason*, have done us a huge service with their powerful argument that our rational skills are optimally suited not to private reflection, as the 'intellectualist' tradition epitomized in Descartes' *cogito* holds, but to social argumentation. However, I think that their position stops short of, and even denies, one of the most striking ways in which reasoning and our social lives may interact: that our rational abilities might, at least in part, be culturally transmitted – learned from others, and passed on across generations.

I. What Aspects of Reasoning Might be Culturally Transmitted?

Perhaps the most powerful way in which culture impacts on individual abilities is through what has been dubbed 'the cultural ratchet' [Tomasello, Kruger and Ratner (1993)]. This is the phenomenon whereby each generation inherits a set of skills that have been honed by the previous one, so that their starting point is 'ratcheted up' from the starting point made available to the generation before, allowing them to achieve much more than their forebears with about the same amount of work. For example, the Wright Brothers managed to build a functioning aeroplane, with more or less no precedents or models to learn from. But once they have succeeded, the task facing the next generation is far less daunting, who inherit a fully functioning airplane from the Wright Brothers. The next generation can now devote their time to advancing the technology further, rather than spending all their time getting to the point exhausted the Wright brothers' abilities. In 1896, we celebrated the invention of Langley's heavier than air flying machine that could carry no pilot and fly only 50 yards; in 1996, roughly four human generations later [Coale (1972), p. 18], we celebrated the Concord, which carries a hundred passengers at the speed of sound in the stratosphere. The scale of

achievement has been transformed, but our genetically endowed cognitive abilities have not changed at all.

Generally, the cultural ratchet is explored for the effects it has on the development of practical skills like building aeroplanes [e.g. Caldwell (2009)]. But it is also possible that the cultural ratchet applies to our rational abilities. We have for many generations been exploring how to improve the conclusions that we draw from evidence in order to maximize certain rational ideals, like truth and informativeness [Huber (2007)]. And each new generation inherits the insights and tools for optimizing reason invented by the previous ones. Might this not result in our rational abilities themselves being slowly transformed? Consider the legacy of Archimedes. Archimedes tasked himself with measuring the size of the universe in terms of the smallest units he could think of – grains of sand. The first problem he faced was that the counting system available only had names for numbers up to 10,000, which was called a 'myriad'. Clearly the universe would fit more than 10,000 grains of sand. To deal with this problem, Archimedes invented a system of counting that is basically a form of exponential counting – using 10^2 to represent 10 to the power of 10, (10^2)^10^2 to represent 100 to the power of 100, etc. Using the same system of number names that at the time could only differentiate numbers up to 10,000, Archimedes could now efficiently notate the number $10^{8*(10\text{^}16)}$, or 1 followed by 80 quadrillion zeros. The real breakthrough, however, came with his discovery of the 'laws of exponents': $10^a*10^b = 10^{a+b}$, and $10^a/10^b = 10^{a-b}$. These allowed him not just to represent these massive figures, but to multiply and divide them. It's sufficient to try to imagine yourself multiplying numbers like 1 followed by 80 quadrillion zeros without using the law of exponents (or a calculator) to see what a huge reduction in cognitive cost this amounts to. Crucially, although Archimedes' labor and genius were needed to spot the law of exponents, once it is identified, it can be learned very easily. In the 17th century, Napier derived a method for calculating the logarithm of a number (if $4^2=16$, then $\log_4 16=2$), which coupled with the law of exponents allowed him to make similar calculations for logarithms. Kepler used Napier's logs to represent the relative motion of planets around the sun, which allowed him to recognize the third law of planetary motion, which in turn allowed Newton to state the inverse square law governing all physical forces.

A more familiar example is long division. In the 17th century, a mathematician called Raymond Briggs devised a series of shortcuts for dividing numbers by one another. It was a huge achievement, that prob-

ably very few people in the world were capable. But once Briggs had accomplished it and published it, it was quickly taken up by the rest of the mathematical community, until eventually it became a standard part of the school curriculum where we learn it today when we are about 9 years old. If I ask my 9 years old niece to divide 136,880 by 865, she can quickly produce an answer, because she has been taught Brigg's method for long division. This would not have been the case in the 17th century. And a more recent invention still, is Gosset's invention of the t-test. Again, an accomplishment that very few people are capable of. But once it is invented, the next generation can easily learn how to use the t-test to confidently assess the probability of two samples displaying a difference greater than what should be expected by chance. Many scientists using the t-test (or similar statistical tools) will readily admit they would have no idea how to make this judgment without such tools.

There seems little room for doubt that the cultural ratchet is at work here. Newton's work depended on Kepler's, which depended on Napier's, which depended on Archimedes'. The work Briggs undertook in the 17th century allows my niece to compute long division today. The efficiency and rigor with which we can reason about empirical data today is incomparably greater than the efficiency and with which Archimedes could, even though Archimedes' genetically endowed quotient of intelligence or rationality is no doubt far higher than that of most users of the t-test. But are these rational skills that are increasing in power across generations? We might expect that abilities to arrive at reliable answers to mathematical and probabilistic questions would be go-to illustrations of the rationality. However, doubts have been raised about whether these kinds of skills count as rational skills.

II. Is this Reasoning?

Perhaps these are not examples of 'quintessential reasoning' (MS371), and a general lesson about rationality should not be drawn from them. M&S argue that the cases I have just considered should not be considered to belong to the domain of reasoning proper. These are cases where we can learn a clear method to deal with a problem, whereas "reasoning doesn't consist in applying such methods" (MS371). By 'methods' they mean the application of formulae – the kind of thing you can learn from someone else, the kind of thing that can be culturally transmitted. Why would they think this? Their main concern seems to be reasoning can be

distinguished from another closely related cognitive activity, which they call 'problem solving'.

Problem-solving, they suggest, is the kind of cognitive activity that we can accomplish by 'method', and that does not involve reasoning. There are certainly clear cases of problem-solving by method that do not involve reasoning. For example, students are often taught to apply mathematical formulae to problem sets without having any idea why they are doing so – learning how to use a log table without realizing that a log table could be used to track the relative motion of planets is one tragic example. Some cognitive activities that proceed by applying a learned rule do not, therefore, involve any reasoning.

However, it is also the case that we can learn rules that change our mind about what counts as a good reason – and that on the basis of discoveries of previous generations. The confirmation bias and the attentional bias are themselves discoveries about reasoning, and we have learned procedures for avoiding them. A naïve observer might take the fact that some pints in his local taste better than the first pint tasted in the bar down the road to mean that the beer is better in his local. But if we have learned that our judgments are subject to biases, then we will recognize that a reason like 'there seems to be a difference to me!' is actually *not* a good reason to believe that there really is any difference between two groups. Tests like the t-test are in effect methods that we use precisely to guard against biased assessment of a set of observations. If we have learned about the rationale behind a t-test, then we know that if a t-test reveals a significant difference between two sets of observations, this *is* a good reason to think there is a real difference between the sets. In other words, this kind of learning improves our ability to assess the strength of competing reasons for believing something.

Since the kind of rules that we use in these cases are indeed inherited and transmitted across generations, and indeed improve in refinement over generations, it seems hard to doubt that the cultural ratchet applies to reasoning at least to some degree.

III. The Extent of the Effect

If our cultural inheritance contributes more broadly to our reasoning abilities, then perhaps we should see its effects not just at the rare level of scientific reasoning. We might expect, for example, that children get better at reasoning due to being taught. Children's basic appreciation for differences between arguments of different strength appears early. By

3-4 they are more convinced by a speaker who offers a distinct reason for her belief than who simply repeats herself [Castelain et al. (2017)], and they find assertions based on evidence ('I saw the ball in the box; the ball is in the box') more convincing than wishful thinking ('I hope the ball is in the box; the ball is in the box') [Koenig (2012)]. By six, they prefer to believe deductive inferences than speculation, by 8-10 years they recognize deduction as more reliable than induction [Pillow (2002)], while adolescents can recognize the difference between validity and soundness – recognizing that an argument can be valid even if its premises or conclusion are false [see Moshman (2009) for review]. It is clear, then, that reasoning develops over childhood. It also appears to be the case that interaction with others is playing a role in this development. Kuczynski and Kochanska (1990) observed that children whose mothers engaged with them using mostly direct orders were less competent reasoners than those whose mothers engaged them in debate. Children's solitary problem-solving abilities improve after they have engaged with a peer who holds a competing view from their own [Doise and Mugny, (1984); Perret-Clermont et al. (2004)], indicating that individual reasoning is improved after engaging in debate with others. Similarly, Kuhn and Crowell (2011) found that children given weekly debating sessions on philosophical topics wrote more impressive argumentative papers at the end of a year than those given traditional didactic instruction – 'by learning to argue together, they had learned to reason better on their own' [M&S, p. 298].

Clearly, reasoning improves over development and that on the basis of interacting with others. However, these results are consistent with holding either that reasoning is culturally transmitted (that we are learning the skills from others), or that it simply takes interaction with other people for our genetically inherited abilities to mature, or to be 'tuned' [Sperber (2018)]. Do we have any evidence for the cultural transmission view? Indirectly, perhaps. Weinstock et al (2004) tasked students with evaluating debates between two characters. In these debates, one character commits an 'informal reasoning fallacy', for example the *ad populum* fallacy, which is an argument along the lines 'everyone believes it, so it must be true'. Students were asked to state whether they thought a particular argument (in which one of the fallacies was committed) was problematic or not. Independently, they were asked to evaluate abstract characterizations of the fallacy that appeared there – for example, "do you think it is right to argue that a certain claim is right just because most people think so". Those who could recognize the problem with the argument in the abstract were much more likely to reject the particular instance of the fallacy. Understanding the

general and abstract form of the fallacy appears to make it easier for children to reject particular instances of such fallacies.

This result may suggest that the children who perform best in these studies are making use of something culturally inherited, or learned, rather than genetically endowed. A genetically endowed 'rationality module', after all, should be expected to deliver intuitive responses to *particular* arguments. If you are presented with an argument like 'I think global warming is a hoax, because everyone around here says so', an intuitive response to this might be to reject it as an unconvincing reason to believe the statement. But should we also expect the reasoning module to deliver for us a generalized statement of why this argument is unconvincing? It seems doubtful that a rationality module should be expected to output theories or principles of reasoning, such as 'in general one should not believe something just because others do'. What we should expect to acquire from cultural transmission, on the other hand, are indeed general principles or 'norms' that are then applied to particular cases. Such norms are clearly culturally transmitted at a later stage, such as the *ad hominem, ad ignorantium,* or *ad populum* fallacies that we read in logic text books, or the law of exponents or t-tests considered above. Since Weinstock's study indicates that the children who were best at recognizing the particular problems were doing so because they grasped general principles of reasoning, this suggests that what was driving their performance was principles they had learned, rather than intuitions delivered by a reasoning module.

Rather than only effecting reasoning at the lofty level of Newton, then, we may already be picking up on general principles of reasoning from others at an early stage. Is this really so surprising? We are all familiar with hearing a parent gently scold a child who brings home a wild story from the playground by saying 'don't believe everything you hear', or after hearing a child defend her actions by saying 'but everyone was doing it!', replying 'if everyone was going to jump off a cliff would you do it too?' Such admonishments just are the enforcement of norms or principles for reasoning. Children's exposure to such principles might well be instrumental to the development of their rationality, which would as a result depend on cultural transmission.

IV. How Could Reasoning be Culturally Transmitted?

If reasoning is culturally transmitted, it would require some kind of mechanism that allows us to learn from previous generations about reasoning. What could this mechanism be? If we can identify such a mecha-

nism, we should expect that children's reasoning abilities would begin to strengthen with its onset.

O'Madagain and Tomasello (submitted) argue that humans possess a species-unique skill that will support this kind of transmission. This is the ability to engage in what we have called 'joint attention to mental content'. Imagine that I propose 'let's go for a picnic on the beach', and you reply, 'I think that's a terrible idea, it's raining'. Notice that the object of this conversation is an idea – the plan for a picnic. It is not a table or a chair or an apple – not something we can see or touch – but rather an abstract plan for the afternoon. In ordinary conversation, humans routinely focus not on external concrete objects in their environment, but on mental contents: beliefs, hypotheses, plans, and indeed reasons. If one person says, 'I think 9/11 was a conspiracy because I read it on the Internet', another person can just as easily say 'that's no reason to believe something so extreme, the internet is filled with nonsense'. In such a case, these two people have begun to have a conversation about a reason for belief. Using this kind of language, humans clearly have the ability to begin learning from one another about reasons, and this kind of discourse is surely sufficient to support the cultural transmission of rationality.

What are the components of this kind of language? First, it involves 'sentential complement clause' structures. These are sentences with the form 'Sally believes that the ball is in the box', which allow us to talk about our attitudes to hypotheses (in this case Sally's attitude of 'believing' to the hypothesis 'that the ball is in the box'). Generally, we cannot talk about our reasons for belief without talking about beliefs first, and the 'sentential complement' structure is necessary for talking about belief. In addition to the sentential complement structure, discourse about reasons will involve what we might call a 'justificatory' clause, that can interact with the sentential complement structure. For example, 'Sally believes that the ball is in the box, because that's where she left it'. The expression after the word 'because' expresses Sally's reason ('that's where she left it') for believing the content of the expression immediately before ('the ball is in the box'). Human language with this much complexity has the resources to permit the direct discussion of reasons.

Growing evidence suggests that this kind of language is playing a role in the development of children's ability to understand the nature of beliefs – something that will be necessary for reasoning. What has been discovered is a remarkable connection between the onset of fluency with these 'sentential complement' structures and children's ability to pass 'false belief tasks'. In these tasks, children have to predict the behaviour

of someone who has a false belief. For example, a character in a story called Sally leaves her ball in a box, and then leaves the room while Anne appears and moves the ball to a basket. When Sally returns, she should be expected to search for the ball in the box, where she left it, and not the basket. When young children are asked 'where will Sally look for her ball?', they give the wrong answer to this question up to around 4 years of age [Milligan et al. (2007)]. It appears to be the case that they cannot effectively keep track of others' beliefs when those beliefs conflict with their own up to this age. Strikingly, their ability to use sentential complement sentences in discourse – which allow us to talk about beliefs – is strongly correlated with their ability to pass the tasks [de Villiers and de Villiers (2000), Lohmann and Tomasello (2003), Hale and Tager-Flusberg (2003)].

O'Madagain and Tomasello argue that the explanation for the correlation is that discourse involving these sentential structures allows us to engage in joint attention to, and 'perspective taking' on, beliefs. If I say, 'I think that it's raining', and you say, 'I don't believe *that*', we exchange attitudes to the claim that it is raining – the content of a belief. Through such discourse children become fluent in thinking about hypotheses as the kinds of things that people have conflicting attitudes to: they learn about the multiple attitudes we can take to a hypothesis – belief, disbelief, certainty, doubt, etc. – and they become fluent in thinking about beliefs under these various attitudes as a result. Given that we have found a strong correlation between discourse with sentential complement structures and our understanding of belief, we should not be surprised if we find a similar correlation between discourse about reasons and children's growing understanding of reasons. And this would indicate that our competence in evaluating and thinking about reasons is indeed being acquired from others at a very early stage.

There are multiple points at which this story can be objected to. Many think that another set of 'false belief tasks' called 'implicit' tasks, which require no language, indicate a grasp of false belief understanding as young as 7 months [and indeed in non-linguistic animals such as chimps Krupenye et al. (2017)]. Here it is shown that infants show surprise (look longer) when a mistaken agent (like Sally) reaches for a toy in the correct location when she has no way of knowing where it was. Similarly, children as young as 2.5 years can pass 'explicit' tasks if their attention is drawn away from their own conflicting beliefs about the ball. However, they still get stuck until around 4 years if their attention is drawn to their own conflicting belief about the location of the ball [Setoh, Scott and Baillergeon (2016)]. Since understanding that beliefs can conflict seems essential to grasping the notion of belief,

it seems that children are not fully understanding what a belief is until they have acquired the linguistic skills described.

On another point, some argue that children as young as 2 years can distinguish circular from non-circular reasoning, which would indicate a very early ability to evaluate others' arguments [Castelain et al. (2017)]. However, it is not clear how to interpret these studies – these children could be evaluating the arguments, or they could simply be more inclined to believe people who provide more information as opposed to repeating themselves. A more robust demonstration of the ability to evaluate arguments might be to recognize and raise *objections* against others' arguments when these arguments have obvious problems. But when Köymen et al. (submitted), provided young children with as much support as possible to identify a problem with an interlocutor's argument, only by 5 years of age were children able to point out the relevant objection to their interlocutor's argument. Three years old were easily able to recall the information that would serve to 'defeat' their interlocutor's argument – but they failed to see what the relevance was between this information and the argument their opponent had raised. On the other hand, when the experimenters provided three-year olds with training in discourse in which the strength of reasons for one or another course of action was discussed, their ability to subsequently identify problems with a peer's argument significantly improved. Simply talking about reasons, it seems, improved children's reasoning ability.

Discourse about reasons could well, therefore, be acting as a vehicle to allow the cultural transmission of reasoning. Training with elements of this discourse (sentential complements) improves performance in something that will clearly be required for reasoning (understanding beliefs), and training with discourse about reasons improves performance in children's ability to critique arguments. There is still plenty of work to do in this area, but the evidence we have so far points in the right direction.

V. Conclusion: Cumulative Rationality and the Argumentative Theory

The argumentative theory in many ways sets the stage for the cultural ratchet to set to work on rationality. If it were not the case that our rational abilities were 'socially directed', we might be disinclined to pay attention to the criticisms of others of our own arguments. But precisely because we are so inclined, and granting most of Mercier and Sperber's account, we are in an optimal position for the cultural ratchet to set to

work on rationality. Rather than reasoning on our own, our arguments are subject to powerful criticism from others precisely because reasoning is oriented toward argumentation. The addition to the story laid out here says no more than that we can learn enough from such encounters to improve our own performance, and that what we learn accumulates across generations. It is a small addition to Mercier and Sperber's story, but the ramifications are substantial.

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