Intuitive skill

Abstract

This article presents a theory of intuitive skill in terms of three constitutive elements: getting things right intuitively, not getting things wrong intuitively and sceptical ability. The theory draws on work from a range of psychological approaches to intuition and expertise in various domains, including arts, business, science and sport. It provides a general framework that will help to further integrate research on these topics, for example building bridges between practical and theoretical domains or between such apparently conflicting methodologies as a heuristics and biases approach on the one hand and one based on naturalistic decision-making on the other. In addition, the theory provides a clearer and more precise account of relevant concepts, which will help to inspire new directions for future research. Intuitive skill is defined as a high level of intuitive ability, that is, the ability to make good use of intuition; specifically, a high level of ability at either getting things right intuitively, not getting things wrong intuitively or sceptical ability, where the latter is the ability to detect instances of getting things wrong intuitively so as to avoid forming incorrect intuitive judgements, which may itself be partly intuitive.

Keywords: intuition, expertise, judgement, performance, discovery

> Whenever the topic of our thinking is at all complicated, which is usually the case, the business of thinking effectively is apt to be slow.
>
> —L. Susan Stebbing, *Thinking to Some Purpose*

> The most effortful forms of slow thinking are those that require you to think fast.
>
> —Daniel Kahneman, *Thinking, Fast and Slow*

1 Introduction

Modern cognitive psychology standardly characterises intuitive judgement as being associative, automatic, effortless, fast, implicit, impulsive, reflexive, spontaneous and unconscious.[1] An underlying distinction which is often left implicit, and sometimes ignored, is that between intuitive judgement and that which it is immediately based on, intuitive appearance or, simply, an intuition (as I will be using the count noun here).[2] The relevant difference is most evident in paradoxical situations that are such that, even though the subject knows that things are not as they intuitively appear, their false appearance tends to persist, so that the subject has an intuition that things are a certain way, but does not judge accordingly; hence, there can be an intuition without intuitive judgement. In order to emphasise the practical dimension of intuitions, in thought as well as action, it will often be useful in the following to speak in terms of getting things right, or wrong, intuitively.

It is easy to see why intuition—the capacity for intuitive judgement in general (as I will be using the mass noun)—has long been considered an important subject of study. Intuition brings out both some of the best and some of the worst in humans. For example, people's reliance on intuition, especially when paired with ignorance and a lack of general education, has allowed powerful individuals and organisations to unduly influence people's thought and action by reinforcing existing prejudice and false beliefs through targeted messaging. On the other hand, intuition is a well-known mark of great mastery or genius, as when someone sees what others cannot see and, therefore, does what others cannot do.[3]

[1] See, for example, Epstein 2010, Glöckner and Witteman 2010, Gore and Sadler-Smith 2011, Hogarth 2001, Kahneman 2003, Klein 1998, Lieberman 2000, Mercier and Sperber 2009, Myers 2002 and Shirley and Langan-Fox 1996.

[2] The distinction is quite standard in philosophy. See, for example, Audi 2015, Bealer 1998, Bengson 2015, Boghossian and Williamson 2020, Chudnoff 2013 and Sosa 2014.

[3] The naturalistic decision-making approach in psychology, after de Groot 1946/78 and Chase and Simon 1973a, has prominently focused on the strengths of intuition; see also, for example, Crandall, Klein and Hoffman 2006, Klein, Calderwood and Clinton-Cirocco 1986, Klein 1998, Schraagen, Chipman and Shalin 2000 and Zsambok and Klein 1997. See further Gigerenzer 2007. The heuristics and biases approach, after Meehl 1954, Goldberg 1970 and Tversky and Kahneman 1971 and 1974, has focused—even more prominently—on the weaknesses; see also, for example, Frederick 2005, Gilovich, Griffin and Kahneman 2002, Kahneman, Slovic and Tversky 1982 and Kahneman 2011. See also Kahneman and Klein 2009.

Desiring to be good at what one does is only rational. So, if sometimes one can do better by doing the same thing but intuitively, and sometimes by doing it non-intuitively, then it must be equally desirable to develop one's intuition to make it adhere to these requirements. For more than half a century, there has been steady growth in work on intuition by philosophers and psychologists, including some detailed philosophical accounts of its nature and epistemology. Unlike their colleagues in psychology, however, philosophers have not paid much attention to the practical dimension of intuition—intuitive action, so to speak—as it is frequently found in business, culture, sports, etc. as well as everyday life.

2 Three elements of intuitive skill

Many people sometimes make skilful—that is to say, highly able—use of intuition. For example, professionals often get things right intuitively that most other people spend a long time trying to figure out.[4] Thus, many people have what might be called 'intuitive skill'. Moreover, some people have exceptional intuitive skill. These people make highly skilful, or highly highly able, use of intuition. A good example of exceptional intuitive skill is that of some of the best chess or go players.[5] Despite the sheer complexity of the game, not only do these players very often identify good or bad moves merely by taking a look at the board, but their intuitive skill is developed to such a degree that they can successfully compete against large numbers of already skilful opponents at simultaneous exhibitions.

Psychological research testifies to the thesis that any given intuitive ability can be developed through practice.[6] However, it has also been shown that many experts do not have great intuitive ability regarding their own area of expertise.[7] This indicates that acquiring intuitive skill may require

[4] See, for example, Abernathy and Hamm 1995, Crandall and Getchell-Reiter 1993, Dane and Pratt 2007, Dane, Rockmann and Pratt 2012, Davis-Floyd and Davis 1996 and Klein, Calderwood and Clinton-Cirocco 1986.
[5] See, for example, Bossomaier, Traish, Gobet and Lane 2012, Calderwood, Klein and Crandall 1988, Campitelli, Gobet and Bilalić 2014, Chase and Simon 1973a and 1973b, de Groot 1946/78, Farrow and Abernethy 2015, Gobet and Charness 2018, Reitman 1976 and Simon and Chase 1973.
[6] See, for example, Ericsson, Hoffman, Kozbelt and Williams 2018, Ericsson 1996 and Plessner, Betsch and Betsch 2008.
[7] See, for example, Bazerman and Moore 2013, Croskerry and Norman 2008, Guthrie, Rachlinski and Wistrich 2007, Kahneman and Renshon 2007, Shanteau 1992 and Sunstein 2000. See also note 3.

additional effort. Acquiring the intuitive skill that is typical of an advanced chess or go player, for instance, normally requires many hours of practice and study, including special effort at improving intuitive play using limited time controls.[8] Each of these games contains vast numbers of possible move combinations that even the latest specially devised machinery struggles to fully calculate within a reasonable amount of time. Yet these games are based on a relatively small set of rules. Perhaps there exist domains of knowledge that are so much more complicated than chess or go that it is impossible to develop an intuitive skill that gets many things right intuitively in these domains. Indeed, real-life human affairs in domains ranging from art, politics and science right down to family, friendship and work all tend to be much more complicated than any board game could possibly be. It should therefore perhaps not be so surprising that experts often get things wrong intuitively regarding their own domains of expertise.

However, even if it were impossible to develop an intuitive skill so as to get many things right intuitively regarding a given domain, one might nonetheless develop one's intuitive ability regarding the same domain into a skill. In principle, there are two ways to do this. First, one can become more reliable at getting things right intuitively by getting fewer things wrong intuitively. An advanced chess or go player not only sees good moves more frequently than someone of an average playing ability does, but also suffers less frequently from illusions of something being a good move when it is not. Second, one can become more reliable at intuitive judgement insofar as one judges fewer of the things that one has got wrong intuitively to be the way they intuitively appear to be. Thus, we can distinguish three constitutive elements of intuitive ability. The first two are getting things right intuitively and not getting things wrong intuitively.[9] The third is detecting instances of getting things wrong intuitively so as to avoid forming incorrect intuitive judgements, which I will call 'sceptical ability'.[10]

[8] See, for example, Campitelli and Gobet 2008 and Gobet and Charness 2018.

[9] The fact that not getting things wrong intuitively is different from any kind of judgement—which will be the case even if it is correctly analysed as lack of an inclination to judge—implies that intuitive ability is different from any kind of judgement.

[10] In terms of dual-process theories in cognitive psychology, sceptical ability would thus be classified as type 2. Type 1 processes—such as getting things right, or wrong, intuitively—demand little of working memory and are not consciously reasoned, while type 2 processes demand more of working memory and are consciously

The three elements are governed by an obvious principle of epistemic priority, which may be represented as follows:

(1) Get everything right intuitively.
(2) Get nothing wrong intuitively.
(3) Make no incorrect intuitive judgements.

The diagram below illustrates the three elements of intuitive ability according to the above principle.

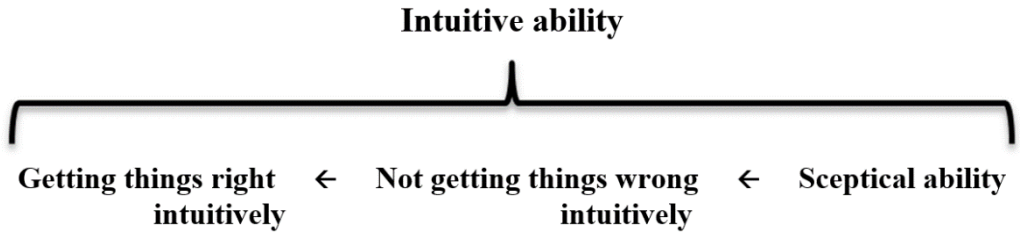

Figure 1: Three elements of intuitive ability according to their relative epistemic priority

In developing one's intuitive ability, one naturally aims to maximise intuitive knowledge, not to minimise intuitive error. Ideally, one will get everything right intuitively. Hence, in the ideal case it would also logically follow that one would not get anything wrong intuitively, nor would there be a need for sceptical ability.[11] In reality, however, intuitive ability in a subject tends to consist of a mix of all three abilities. Another reason to take all three of them seriously, from a theoretical perspective, is that each is a sufficient condition for intuitive skill to occur. One's intuitive skill may exclusively consist either in getting everything right intuitively, in getting nothing wrong intuitively or in possessing perfect sceptical ability.

This last point can be demonstrated using a well-known example from the psychological literature.[12]

> A bat and a ball cost $1.10 in total. The bat costs one dollar more than the ball. How much does the ball cost?

reasoned. See, for example, Evans and Stanovich 2013 and Evans 2018. However, sceptical ability is ideally developed in a way that combines type 1 and type 2 processes (more on which in section 6 and note 27).

[11] This may partly explain why philosophers, unlike psychologists, have been almost exclusively interested in intuitive expertise, that is, a high level of ability at getting things right, and not wrong, intuitively. See also note 34.

[12] The example is taken from Frederick 2005.

First, many accountants, cashiers and others who deal with similar questions on a daily basis would probably get this right intuitively.

Second, many people actually get this case wrong intuitively. Perhaps the most common intuition is that the ball costs ten cents. But it does not, it costs five. An apprentice accountant or cashier, at a certain stage in their apprenticeship, would perhaps not get this kind of case wrong intuitively, whilst not getting it right intuitively either.

Third, some readers will probably have distrusted their intuition that the ball costs ten cents, and so they may have prevented themselves from forming an incorrect intuitive judgement.

Given that each of the three constitutive elements of intuitive ability is a sufficient condition for intuitive skill to occur, it follows that none of them is a necessary condition. But since they jointly, and fully, cover all of the possible grounds from which intuitive skill may arise—correct intuition, no intuition and incorrect intuition—they are, together, disjunctively necessary. Hence, we can formulate the following definition of intuitive skill.

> A subject has intuitive skill
>
> *... if, and only if, ...*
>
> the subject has a high level of ability at
>
> | | |
> |---|---|
> | either | getting things right intuitively |
> | or | not getting things wrong intuitively |
> | or | sceptical ability. |

3 Getting things right intuitively

Getting things right intuitively requires knowledge of the matter in question. The requisite knowledge may be of a predominantly practical nature, so that someone who gets many things right intuitively need not be able to fully articulate how they know what they know. This holds true of high-level cultural performances—sports, dance, theatre, etc.—as well as everyday activities such as voice

recognition, spatial orientation, moral judgement or recognising one's favourite piece of music from hearing just a tiny fragment of it.[13]

The degree to which the knowledge required to get things right intuitively may be of a practical nature varies between different subjects and objects. Accordingly, the training required to get more things right intuitively may consist of varying amounts of practice and theoretical study, depending on the domain, the particular task at hand and the characteristics of the learner.[14] For example, getting more things right intuitively in chess or go tends to require a greater proportion of practice over study as compared with getting more things right intuitively in biology. But it may be the other way round for other tasks, which may predominantly require, say, laboratory practice in biology and theoretical analysis in chess and go. And sometimes, especially in practical fields, theoretical study can actually have a negative effect, for example by making a person overthink and thus effectively lose some of their intuitive ability at least temporarily.

The following general principle holds nonetheless. For any iterable human activity, by virtue of practice and study one may, and typically will, improve an ability to get things right intuitively.

It might be argued that there are notable exceptions. For example, studies have shown that significant numbers of experts in various domains do not in all central respects get more things right, and sometimes even get more things wrong, intuitively than laypeople do.[15] However, giving serious thought to anything quickly reveals significant depth and complexity. Therefore, although almost everyone can get something right intuitively regarding many domains of which they are not experts, becoming an expert in the domain requires a lot of hard work, and improving one's ability to get things right intuitively is likely to require additional effort. Moreover, I have already noted that, for instance, there exists in some practical fields a special risk of overthinking, and thus of losing

[13] See, for example, Ericsson and Lehmann 1996, Ericsson 1996, Evans 2008, Haidt 2001, Mann, Williams, Ward and Janelle 2007, Savelsbergh, Williams, Kamp and Ward 2002, Shim, Carlton, Chow and Chae 2005 and Sternberg et al. 2000.

[14] See, for example, Reber 1993 and Seger 1994.

[15] See, for example, Adelson 1984, Christensen et al. 1991, Frensch and Sternberg 1989, Hashem, Chi and Friedman 2003, Lewandowsky, Dunn, Kirsner and Randell 1997, Marchant, Robinson, Anderson and Schadewald 1991, Rosenzweig 2007, Schliemann and Carraher 1993, Schmidt and Boshuizen 1993, Voss, Vesonder and Spilich 1980 and Wiley 1998. For an overview, see Chi 2006.

intuitive ability at least temporarily, as a consequence of high-level theoretical study. So it should perhaps not be very surprising if experts, especially without evidence of extra effort, do not in all central respects get more things right intuitively regarding their expert domain than laypeople do.

There are, however, reasons to believe that the extent and degree to which one may develop an ability to get things right intuitively is in fact systematically limited. There are things which, for non-trivial reasons, it may be impossible for modern humans to get right, or even not to get wrong, intuitively. And there are environments that are such that no prior practice or study is likely to offer sufficient preparation. The remaining sections of this article will explore these issues by further reflecting on the other two elements of intuitive ability: not getting things wrong intuitively and sceptical ability. But first, a radically sceptical argument from the recent philosophical literature needs to be rejected.

4 Interlude: calibration

There is a general argument, well known albeit rarely made fully explicit, according to which intuition cannot be a useful source of evidence for the purpose of directly confirming or disconfirming a given hypothesis. The most widely discussed variant of this type of argument is that by Robert Cummins, which proceeds in terms of an analogy with the calibration of scientific instruments. Cummins restricts the scope of his argument to philosophy, but it is easy to generalise so that it pertains to any genuine pursuit of knowledge.[16]

The argument can be formulated using the following schema.

P1) a → b
P2) b → c
P3) c → d
P4) d → not-a
C1) c → not-a
C2) b → not-a
C3) a → not-a

[16] See Cummins 1998; see also, for example, Ryberg 2013, section 3.

Thus, the argument runs as follows.

P1) Intuition will be a useful source of evidence, only if it is known to be sufficiently reliable.
P2) Intuition will be known to be sufficiently reliable, only if it is calibrated.
P3) Intuition will be calibrated, only if its object is accessed independently of intuition.
P4) But, if its object is accessed independently, it will not be a useful source of evidence.
C1) So, if it is calibrated, it will not be a useful source of evidence.
C2) So, if it is known to be sufficiently reliable, it will not be a useful source of evidence.
C3) So, intuition cannot be a useful source of evidence (because it will be only if it is not).

The central idea, contained in the fourth premise, is that, since calibration requires intuition-independent access, calibration makes access via intuition redundant. So intuition is useless, because either it is not calibrated or it is calibrated but hence also redundant.[17]

Calibration is a process of testing the reliability of a given instrument and, where possible, increasing it. The process essentially requires accessing objects of the relevant type in a way that is independent of the instrument one wishes to calibrate, so that one may determine the accuracy of a given output of the instrument. In this way, one will be able to identify (and, ideally, adjust for) possible data corruption that the instrument may be prone to introduce. Once the instrument has been calibrated, it is safe to use in similar conditions.

Cummins offers the following useful illustration:

> When Galileo pointed his newly devised telescope at the moon and saw mountains—earthlike blemishes on what should have been a perfect celestial object—it was legitimate for the opposition to inquire whether the apparent mountains were artifacts. The proper response was to point the telescope at something of known size, shape, distance, color, and so on to determine what distortions it introduced; to calibrate it, in short. (Cummins 1998, 116–17)

Contrary to what Cummins and others have suggested, a plausible case can be made for the claim that intuition can be calibrated for the purpose of directly confirming or disconfirming any given hypothesis, in broadly the same kind of way in which a telescope can be calibrated. For example, intuition can be calibrated for fairness—which is the main example used by Cummins—in the same way in which a telescope can be calibrated for mountains. In either case, one takes easy and familiar

[17] The idea is a natural one. My grandfather once shared with me an apparently simple trick for catching hares. 'You just have to sprinkle a bit of salt on the hare's tail,' he said. Of course, in order to do that you have to catch it first! So my grandfather's method is at best redundant.

instances and accesses them independently of the method to be calibrated so as to test the correctness of the method's outputs. When calibrating a telescope for mountains, one may take familiar mountains and access them independently, perhaps on foot or by helicopter, to test the correctness of the telescopic data. Analogously, when calibrating intuition for fairness, one may take familiar cases and access them independently, mainly through discourse and analysis, to test the correctness of the intuitive data.

For instance, calibration of intuition for fairness may proceed along the following lines. A baker is supposed to distribute a cake amongst three people. Which of the following principles are fair distribution principles and which are not?

1) The baker divides the cake into	3 pieces	of equal size	and gives one	to each person.
2) … … … … … …	… …	of varying sizes	… … …	… … ….
3) … … … … … …	4 pieces	of equal size	… … …	… … ….
4) … … … … … …	2 pieces	… … …	… … …	to each of two.
5) … … … … … …	6 pieces	of varying sizes	and gives two	to each person
	such that all three have approximately the same amount of cake.			
6) The baker eats the cake.				

Suppose that A and B have differing intuitions about (2), (3) and (6). In each case, A's intuition is that it is not a fair distribution principle.

(3) Baker divides cake into 4 pieces – equal size – one for each person
A: either one person gets an extra piece or all three get less cake than they were supposed to
B: all three get an equal amount of cake, what happens to the extra piece is irrelevant
After some discussion, they agree that it is a fair distribution principle and B's intuition was more accurate.

(6) Baker eats cake
A: not a distribution principle at all (hence not a fair one)
B: all three get an equal amount of cake, namely none
After some discussion, they agree that it is not a fair distribution principle and A's intuition was more accurate; they also agree that B wrongly presumed the baker was not one of the three.

(2) Baker divides cake into 3 pieces – varying sizes – one for each person
A: the pieces are not of equal size
B: the degree of variation is left unspecified, hence the principle is neither fair nor unfair
After some discussion, they agree that it is not a fair distribution principle and B's intuition was more accurate.

The procedure might be continued indefinitely. For example, using variations in which someone is supposed to distribute something other than a cake, say, a given sum of money, A and B may find that they have different thoughts and intuitions about the money-versions of (2) and (5) as compared with the original cake-versions. Distributing slightly unequal amounts of money tends to seem less fair than distributing slightly unequal amounts of cake. As the process continues, it will naturally become more and more convoluted. In reality, the resolution of disagreement will quickly become very difficult, consume a lot of time and require enormous resources. However, this gives no reason to believe that the calibration process cannot be continued further or that it will not be successful. On the contrary, it is plausible that the same kind of process may in principle be successfully employed to calibrate intuition for anything that a subject might have intuitions about. And following each successful step in the calibration process, one may proceed to apply the method to new, similar cases by allowing slight parameter changes as compared with the cases by which the method was calibrated.

Thus, intuition can be, in virtue of successful calibration, a useful source of evidence for the purpose of directly confirming or disconfirming any given hypothesis. The central idea of the opposing argument—that, since calibration of intuition requires intuition-independent access, calibration makes access via intuition redundant—is natural, but misleading. Cummins, for example, falsely assumes that the only intuition-independent access would be through, more or less established, theories. His making this assumption is probably the result of his focus on intuitions in philosophy and the method of reflective equilibrium as he sees it. The assumption quickly leads him to the conclusion that intuition cannot be a useful source of evidence, on the grounds that one 'could have no possible use for intuition in a context in which the relevant theory was well enough settled to form the basis of a credible calibration test' (1998, 118). However, the stepwise calibration procedure outlined above is a credible one without depending on any particular theory for intuition-independent access. The only thing required is careful reflection on particular cases.

The real problem, as will be seen in the next section, is that even successful calibration can only ever provide so much certainty.

5 Not getting things wrong intuitively

However much one may improve one's intuitive ability, one will normally continue to get many things wrong intuitively. There are things which it may be impossible for modern humans to get right, and indeed not to get wrong, intuitively. For example, some sensory illusions are deeply paradoxical. Akiyoshi Kitaoka's picture *Rotating Snakes* is a static image, but avoiding the appearance of its being in motion whilst seeing it clearly from close range is very difficult if not actually humanly impossible. Even though the subject knows that things are not as they intuitively appear, their false appearance tends to persist.

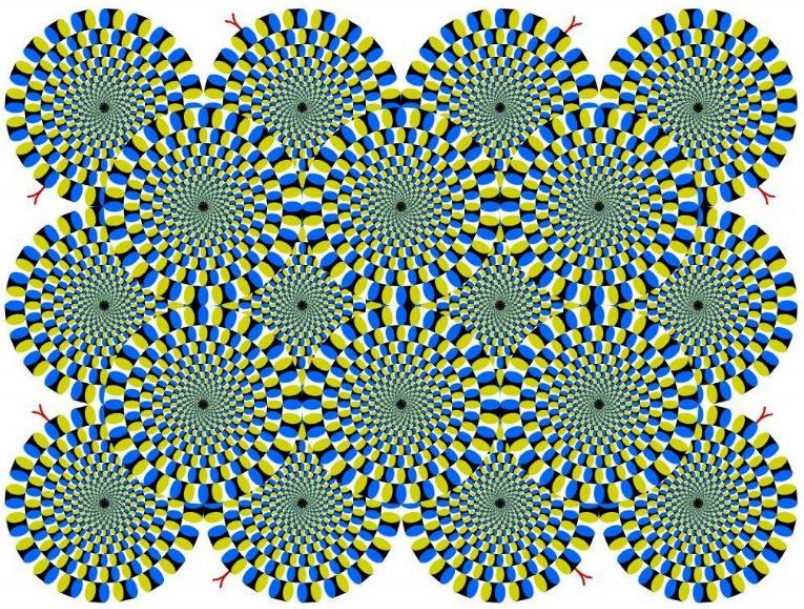

Figure 2: Rotating Snakes, *Akiyoshi Kitaoka, 2003, http://www.ritsumei.ac.jp/~akitaoka*

Another example is the thermal grill illusion. An interlaced grill of warm and cool bars will give one the illusion of burning heat if one presses a hand or finger across the bars.[18] Similarly, the most interesting verbal paradoxes—liar, sorites, Russell's, etc.—can be presented in such a way that both a given statement and its contradiction may intuitively appear true to one at the same time.

[18] See Craig and Bushnell 1994 and Thunberg 1896. A similar type of auditory paradox is the Shepard scale; see Deutsch 2010 and Shepard 1964.

Furthermore, psychological research has shown that our getting things wrong intuitively is often caused by a failure of cognitive heuristics, which are like shortcuts in our cognitive processing.[19] The intuition that the ball in the bat-and-ball case costs ten cents is a paradigmatic example of a shortcut gone wrong. People are somehow misled into mistaking this case for one that would be easier to get right but actually is not the case in front of them.[20] This kind of failure of cognitive heuristics is known as cognitive bias. Two well-known types of cognitive bias are order effects and framing effects. The way (order, frame, etc.) in which something appears to a subject may easily and unduly bias the subject's cognitive processing. Most people will have at least some familiarity with these kinds of effects, because they are commonly exploited in advertising, journalism and politics. There are dozens of types of cognitive bias that are standardly distinguished by psychologists. In addition, there are other common causes of getting things wrong intuitively, including wishful thinking, ideology and theoretical preconceptions. All of these common causes are deeply rooted in human nature and closely related to what enables humans to function as rational agents. Consequently, reducing one's susceptibility to getting things wrong intuitively below a certain level is difficult, and trying to cut off the root cause of this susceptibility would potentially have a paralysing effect.

General practice and study will typically not only improve one's ability to get things right intuitively but also reduce one's susceptibility to getting things wrong intuitively. All else being equal, getting more things right intuitively regarding a given matter entails a reduced susceptibility to getting things wrong intuitively regarding that same matter, because getting something right entails not getting it wrong. There will normally also be an independent reduction. In addition to general practice and study, deliberate practice is possible too, including task-specific training. For example, it is possible to try and become less susceptible to some cognitive biases at least in some situations. Similarly, one may try and improve with a focus on particular scenarios, including particular kinds of deception (camouflage, feints, lies, rhetoric, etc.), illusion, strategy, stress, tiredness and so on, that one expects to encounter in a given environment or when facing a certain opponent.[21]

[19] See especially the work following the heuristics and biases approach; see notes 3 and 7.

[20] See Kahneman and Frederick 2002.

[21] See, for example, Endsley 1995, Ericsson, Krampe and Tesch-Römer 1993, Ericsson 2018, Eysenck, Derakshan, Santos and Calvo 2007 and Eysenck 1982.

There exists, however, a systematic problem in connection with new cases. The vast majority of interesting domains are such that in practice one often does not know just how new what one may encounter might be. Moreover, knowing how new a given case is—in other words, how much it is like, or unlike, ones one has previously encountered—can be difficult. Thus, this type of new case is such that no prior practice or study may prevent one from getting such cases wrong intuitively. The principle generally applies in chess and go, so it potentially applies everywhere in real life.

The possibility of this kind of novelty sets a subjective limit to the calibration of intuition. As was argued in the previous section, intuition can be calibrated—and thus be known to be sufficiently reliable—for the purpose of directly confirming or disconfirming any given hypothesis, on the basis of a controlled procedure using small steps. However, the further we move outside the parameters of this controlled procedure, the more uncertainty we allow regarding the reliability of intuition. The same holds for the calibration of other methods. In Galileo's times, a telescope that had been calibrated for mountains, using earthly mountains, might still reasonably have been taken as unreliable when it comes to what appear to be mountains on the moon.

At the same time, it is only natural that a scholar like Galileo may wish to make the leap from telescopic images of mountains on the earth to what appear to be mountains on the moon. If we want to make progress, we sometimes need to be ambitious and optimistic in a similar way. Making progress is an essential purpose of using intuition. It is supposed to allow us to make leaps, that is, faster progress than smaller, more rigorous steps would often allow.[22] Of course, faster progress normally comes at a higher risk.

The size of the leap—the speed and extent of the progress we attempt—corresponds to the objective component of the problem arising from new cases. This objective component may be summarised, greatly simplifying, as follows. The more complex the matter at hand, the more ways there are to get things wrong, including getting things wrong intuitively. All else being equal, the more complex the matter at hand, the more susceptible a subject tends to be to getting things wrong intuitively. Thus, explorers and innovators—in business, politics, science, sports, technology and any

[22] For an overview of the use of intuition in science, see Davis-Floyd and Arvidson 1997. See also note 32.

other field—are especially likely to find, or indeed put, themselves in the kind of environment in which one would rightly distrust one's intuition. Working at the cutting edge of a body of knowledge entails active involvement with complex, unfamiliar matters, whilst the aim to explore or innovate gives one reasons to take risks.[23] In general, striving for excellence makes the use of intuition both desirable and risky, and so it makes desirable the development of all three elements of intuitive skill: the abilities to get things right, and not wrong, intuitively as well as sceptical ability.

6 Sceptical ability

Sceptical ability is a form of self-control; specifically, the ability to detect instances of getting things wrong intuitively so as to avoid forming incorrect intuitive judgements. Most people already have good sceptical ability regarding at least some domains. For example, many people know that the claims of product advertisements are often misleading and have learnt to control themselves appropriately by exercising their sceptical ability. Similarly, many people know that heightened emotional states are often not conducive to good decision-making and have learnt to control themselves appropriately on at least some occasions, perhaps with a bit of luck or when they have specially resolved to do so, by exercising their sceptical ability.

It is often reasonable to question the reliability of one's intuition, and sometimes unreasonable not to. The ongoing evolution of post-truth politics, fake news and online fraud has made the development of sceptical ability amongst the general population perhaps more pressing than ever. But questioning the reliability of one's intuition is generally difficult; more difficult, for instance, than questioning the reliability of a telescope or someone else's intuition, for that matter. Not only does our cognitive processing consist of a near-constant stream of more or less conscious intuitive appearances, but the fact that things intuitively appear to be a certain way also normally entails that

[23] A possible factor raising the risk in this already high-risk environment is the kind of inflexibility associated with expertise that has been found in some groups of experts; see, for example, Marchant, Robinson, Anderson and Schadewald 1991, Schliemann and Carraher 1993 and Sternberg and Frensch 1992; see also Kuhn 1962/70, 90. On the other hand, Bilalić, McLeod and Gobet 2008 shows expertise-dependent inflexibility to decrease again from a certain level of expertise and upward; see also Dane 2010 and Feltovich, Spiro and Coulson 1997.

alternative ways for the same things to be do not appear to one at the same time and, indeed, that relevant alternative ways for things to be are relatively distant from one's mind.

Still, a significant number of people will actually have sceptical skill, because sceptical ability is naturally cultivated in professions that specialise in discovering facts in adverse environments, including journalism, law and politics as well as business, sports and warfare.

All three elements of intuitive ability will typically improve through general practice and study in a given domain. In the case of sceptical ability, knowledge of the matter at hand helps when it comes to noticing alternative ways for things to be. Misleading speech, for instance, will be more easily detected if one knows that what is being made to intuitively appear true to one is actually false. But what sceptical ability essentially requires is self-knowledge of one's cognitive weaknesses, specifically one's susceptibility to getting things wrong intuitively. Task-specific training is likely to be particularly effective, so that one may learn what kinds of things one is most susceptible to get wrong and under what kinds of condition (confidence, excitement, lack of interest, noise, time pressure, etc.). Study of relevant psychological works on cognition, expertise, intuition, etc. will naturally help too. For example, any serious businessperson should probably read about anchoring effects. Moreover, studying relevant philosophical works on logic, decision theory, etc. may help. Anyone professionally trading in arguments, from journalists and politicians to lawyers and scientists, should probably at least read about common logical fallacies.[24] In general, practising and studying philosophy is likely to improve one's sceptical ability, insofar as it is likely to improve one's precision of thought, including the capacity for asking critical questions.[25]

Ideally, sceptical ability is developed to be intuitive itself, so that its exercise may be an unconscious process, at least up to the point at which it intuitively appears to one that one has got something wrong.[26] For example, an experienced chess or go player may have become so attuned to

[24] To give another example, many journalists in particular would benefit from reading Harry Frankfurt's theory of bullshit. See Frankfurt 1986.

[25] For some empirical evidence of a significant correlation between philosophical training and an increased general sceptical ability, see Livengood et al. 2010.

[26] A useful analogy is the perception of risk; see, for example, Slovic and Peters 2006. On intuitive self-knowledge, see Lieberman, Jarcho and Satpute 2004 and, further, Moran 2001.

their getting things wrong intuitively under certain circumstances—an unfamiliar opening, after a long middle game, when feeling confident, when feeling frustrated, etc.—that they can often intuitively detect their getting things wrong intuitively under these circumstances. Most people will be familiar with this kind of experience. It commonly occurs in the form of, as we say, biting one's tongue. In general, it is like stopping one's thought or action in its tracks because one senses that there is a problem. This intuitive part of sceptical ability basically consists of intuitions about intuitions, and might therefore also be described as meta-intuition or, more fully, higher-order intuitive ability.[27] Sceptical ability developed to this level will often make a big difference in terms of efficient thought or action. Biting one's tongue, stopping one's thought or action in its tracks, tends to save time and effort.

7 Conclusion

Difficult problems, tricky situations and smart opponents call for a careful approach. Experience teaches us that our intuition is not always reliable, and psychological research has shown that it is indeed often surprisingly unreliable. So it can seem that we should generally rely less on intuition, and instead practise more slow thinking (and acting), and less of the fast, intuitive sort. There is truth in this. But an obvious reason to search for an alternative solution is that our time tends to be limited. Moreover, our small working memory limits our capacity for slow thinking, which tends to make it even more effortful and time-consuming. In general, to do the same thing faster is to do it better. Fortunately, psychological research also shows that one can improve one's intuition. It is in fact plausible, as I have argued, that by virtue of practice and study one may improve an ability to get things right intuitively for any iterable human activity, and that intuition may be a useful source of evidence for the purpose of directly confirming or disconfirming any given hypothesis in virtue of successful calibration. However, this is not to say that one can develop an ability to get things right intuitively for any iterable human activity, nor that in practice intuition is likely to always be a useful source of evidence. Indeed, I have argued further, it is also plausible that there are things so deeply

[27] In terms of dual processing, meta-intuition will naturally be classified as type 1. On the default-interventionist theory of dual processing, the resulting kind of intervention may be conceived as a conflict between two type 1 processes. See, for example, Evans 2018 (especially 146–9).

paradoxical that they are impossible for modern humans to get right, and perhaps impossible not to get wrong, intuitively. People normally operate in environments that are such that no prior practice or study is likely to offer sufficient preparation for all the types of new cases they may encounter, simply due to the complexity of the world we live in and the fact that it tends to be practically impossible to stay within the limited parameters for which intuition may have been calibrated. Herein lies the importance of what I have proposed as the third element of intuitive ability, in addition to getting things right intuitively and not getting things wrong intuitively: sceptical ability.

On many occasions, one may reasonably expect that one will get something wrong intuitively, for example when reading about a test case in a paper on intuition, visiting a website on illusions, negotiating with a used-car dealer, attending a political speech, competing against a new player or feeling anxious, excited or tired. Expecting this to happen, one may then try and detect one's getting something wrong intuitively and thus avoid forming an incorrect intuitive judgement. In other words, one may try and exercise one's sceptical ability. Arguably, if all of humanity could be made to attend a single one-day workshop, teaching general sceptical skill would be humanity's best bet. But sceptical ability is equally important at the highest levels of excellence. Striving for excellence, in any given domain, means operating in a complex environment of uncertainty whilst being under pressure to make progress; hence, the use of intuition will be risky yet desirable, and so a high level of sceptical ability would seem particularly important.

In principle, a subject may improve each element in a given intuitive ability through general practice and study. In addition, each element may be improved through deliberate practice and study including, especially once a high level has already been attained, study of relevant psychological works. All three elements tend to benefit from self-knowledge of one's cognitive strengths and weaknesses; specifically, of one's respective dispositions to get things right, or wrong, intuitively, and hence of what kinds of things one is most likely to get right, or wrong, and under what conditions. Thus, a subject may for instance learn to avoid some unnecessary risk of getting things wrong intuitively.[28] Similarly, most people know of the importance of being in the right state of mind in

[28] See also Kahneman 2011, 340–1.

order to perform at one's best, but the most excellent performers tend to have good knowledge of how they can reach this kind of state.[29]

Sceptical ability, especially in theoretical fields, may also be improved through practice and study of philosophy. Wittgenstein, in the course of diagnosing problems with Gödel's own explanation of his famous incompleteness theorems in mathematical logic, gives a vivid description of the kind of sceptical skill that practice in philosophy may potentially afford.[30]

> People who have never carried out an investigation of a philosophical sort, like most mathematicians for instance, are not equipped with the right optical instruments for that sort of investigation or scrutiny. Almost, as someone who is not used to searching in the forest for berries will not find any because his eye has not been sharpened for such things & he does not know where you have to be particularly on the lookout for them. Similarly someone unpractised in philosophy passes by all the spots where difficulties lie hidden under the grass, while someone with practice pauses & senses that there is a difficulty here. (Wittgenstein 1977/98, 33e)

Of course, this is not to say that all philosophers have great intuitive skill, or even great sceptical skill. Unsurprisingly, psychological studies have shown that philosophers do not in all central respects get more things right intuitively within their own specialised subdomain, and sometimes even get more things wrong, than laypeople.[31]

The theory of intuitive skill which I have presented shows that, contrary to a tendency in the philosophical literature on intuition, the question of the epistemic value of intuition should not be restricted to the question of whether intuition is a useful source of evidence for the purpose of directly confirming or disconfirming a given hypothesis. First, in reality even the most reliable subject's correct intuitive judgements will often constitute no more than weak evidence, if the environment is so complicated—as it often is—that their intuition is not known to be sufficiently reliable. But although intuition may well not, then, be a useful source of evidence for the purpose of directly confirming or disconfirming a given hypothesis, the weak evidence it provides might still be useful, albeit indirectly, insofar as it might corroborate one's other evidence. Second, even false intuitions can be of significant use, insofar as they may still point in roughly the right direction. Thus, even

[29] See, for example, Csikszentmihalyi 1990 and Dane 2011.
[30] On Wittgenstein's critique of Gödel, see Floyd and Putnam 2000 and Kienzler and Sunday Grève 2016.
[31] See, for example, Machery 2017 and Schwitzgebel and Cushman 2012 and 2015.

false intuitions may allow faster progress than smaller, more rigorous steps would allow, assuming that the subject also exercises their sceptical ability in order to detect that they have not got it quite right intuitively. Indeed, such an intuition-led trial and error approach is a common strategy, and it is widely used by experts in all kinds of domains, both practical and theoretical.[32]

An exact measure of intuitive ability, including a function of measures for its three constitutive elements and a threshold for intuitive skill, remains to be determined.[33] From a conceptual point of view, the following may seem an attractive option. Given that some level of intuitive ability is a necessary and sufficient condition for intuitive skill as well as for the reliability of one's intuitive judgements, we may perhaps have the respective thresholds coincide with each other, so that intuitive skill and the reliability of one's intuitive judgements would be logically equivalent. However, it seems possible to develop intuitive skill in a domain where, say, everyone else constantly makes false intuitive judgements, such that one could have an exceptionally high intuitive ability—that is, intuitive skill—despite still making many, and mostly, false intuitive judgements (so that one's intuitive judgements are not reliable).[34]

The theory of intuitive skill offers a new perspective in the study of intuition, and opens up new directions for future psychological research. Its conceptual and epistemological framework is clear, precise and rigorous. In developing their intuitive ability, up to the level of skill and beyond, people naturally and rightly tend to aim for the maximisation of intuitive knowledge. This will normally require developing all three constitutive elements of intuitive ability and skill. The aim of maximising intuitive knowledge dictates the following order of epistemic priority: getting things right intuitively, not getting things wrong intuitively and sceptical ability. The latter is the ability to detect instances of getting things wrong intuitively so as to avoid forming incorrect intuitive judgements, which may itself become in part intuitive.

[32] See, for example, Bowers, Regehr, Balthazard and Parker 1990, Csikszentmihalyi 1996 and Marton, Fensham and Chaiklin 1994.

[33] For an overview of existing literature on measuring intuition, see Dane and Pratt 2009.

[34] The case of intuitive expertise is different. Intuitive expertise may in principle be correctly conceived as logically equivalent to the reliability of one's intuitive appearances or judgements; but only if one takes reliability to entail that a subject actually gets many things right intuitively, rather than just a certain ratio of things, which might equally mean that the subject actually gets next to nothing right intuitively.

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