Making Complex Decisions Rapidly

By James Lawley | Published 21 Mar 2012

"Complex Decisions: Difficult to Make, Difficult to Model?" was the title of a talk I recently attended at the University of Sydney given by Dr. Michael Harré.[1] Harré presented findings from his research on expertise, artificial neural networks and neuroscience into how people make rapid decisions in complex situations.

The lecture itself was highly complex so I had plenty of opportunity to practice my skills in rapid decision making regarding what to pay attention to, and what to ignore (his differential equations, for example). Below are the key points I took away from the talk, followed by some thoughts on a new way I am trying to conceive of decision making.

The first thing to note is that there are two kinds of 'experts'. There are the ones we all think of – chess grandmasters, concert pianists, etc. And then there are the everyday Jill and Joe's who do expert things like instantly recognise a face in a crowd or understand an ambiguous situation – things that even the world's most powerful computers still struggle to do. Harré predicted that it could be 30-50 years before computers can do these things as fast as humans.

Secondly, the complexity of a decision is first and foremost determined by the complexity of the context in which it is taken. Harré defined a complex decision as one that involves:

- No normative solution [i.e. no standard behaviour]
- No simple optimization of impact [i.e. the consequences are not fully known]
- Noisy or ambiguous information [i.e. it is not obvious what is important]
- Non-trivial contextual environments [i.e. no simple patterns]
- Little direct access to cognitive strategies [i.e. no known how to's]

So how do humans sum up a complex situation and rapidly decide what action to take?

At a biochemical level it involves very large neural networks. Harré maintains that "fifty years of research shows that we don't understand what neural networks are doing."[2] Furthermore, experts make decisions faster and more accurately than models based on logic predict they should. So they must be doing something more than using logic.

One way to find out what that might be is to compare experts with novices and average Jill's and Joe's.

Comparing experts with novices

Not surprisingly there are big divergences between how novices and experts take complex decisions. Novices can handle situations where they need to make sense of a small range of patterns, and people with skill levels between novices and experts can do the same for contexts with a more involved range of patterns. So far so linear. But the surprise comes with experts who can process situations with greater complexity than would be expected with a linear increase in skill. They are not just quantitatively better, it's like they have made a leap to another level of analysis that enables them to do things the rest of us can barely imagine – without knowing how they are doing it.[3]

By tracking saccades – rapid movements of the eyes – scientists can tell which part of a scene is being looked at, in what order, and for how long. Using the games of chess and Go as the context, researchers have discovered that:

- Amateurs only draw upon 15% of the contextual cues picked up by professionals.
- Experts' eyes gaze on the salient areas on the board more often and more consistently than novices.
- Experts have greater flexibility in the way they look at the game.

So that's what the eyes do, but what are people doing behind their eyes? Apparently we are highly selective in what we attend to. We do not take in the whole of a scene in one go. Instead we make sense of scenes by first recognising features like shapes, relative sizes, relative locations, and areas of high-density information (e.g. the boundaries between areas and the edges of things). For example, we use roads, rivers and mountains to provide perceptual and context cues from which we comprehend the whole scene.

The multiple templates model

Harré proposes a multi-layer model. Each layer has "multiple templates that are decoupled from each other". I doubt these templates are fully independent given that everything in the brain is connected to something else, so I assume Harré meant loosely coupled.

As perceptual information is received by the eyes, key features are compared with a number of *perceptual* templates *working in parallel.* Matches and mismatches with each template are noted. When one of the templates has sufficient matches it crosses a threshold, becomes the dominant model and "a single perceptual cue" is passed to the next layer.

The partially processed perceptual information is compared simultaneously with multiple *contextual* templates also working in parallel. These provide more scene analysis. The process of matching or mismatching is repeated but at the level of context rather than perception.[4] When one of the contextual templates has registered enough matches, information is passed on for higher-order processing and for decisions about what action to take.

The use of templates speed up processing because a feature can be compared with many template one once and it's quicker to match a pre-existing template than to re-analyse the attributes of the feature each time.

In sum, current ideas about how we take complex decisions, can be simplified as:

> Perceive *local* features >> recognise context >> *global* higher-order processing.
>
> Perceive *global* features >> recognise context >> *local* higher-order processing.

Harré said we almost certainly do both and he thinks experts do more of the latter. Either way, it seems that we analyse a scene by simplifying the world into recognisable perceptual and contextual cues. In other words we are continually looking for structures and patterns in the environment that will cue us to the kind of context we are in, and hence significantly reduce the range of appropriate behavioural choices that are available to us.

As with everything that happens in the brain, this is not a one-way process because the templates provide feedback which influences the processing at lower levels., e.g. how the eyes move. This is why people are so easy to fooled by with visual illusions – even when they know they are illusions. As long as the appropriate contextual cues are provided the template-matching process ensures that we see what we 'should' see and not what another part of the brain knows is actually happening.[5]

Evidence that matches our templates speeds up decisions, while counter-evidence slows it down. This means the more templates you have, and the wider range of templates, the more chances of finding a match. I suspect this is the basis of an expert player's greater flexibility in *the way* they look at a game – an idea predicted by Gregory Bateson's Levels of Learning theory.[6]

In situations that require rapid decisions the lion's share of processing seems to be associated with comprehending the context. Fighter pilots have to decide what kind of situation they are in before they do anything else. With todays technology, blowing up a house is a relatively simple matter. As we have seen so often in recent wars, mistaking the context costs lives – and usually civilian lives. This finding has huge implications for training therapists, coaches and other facilitators since they too have to take rapid decisions in complex situations.

Harré's multiple template model has parallels with Daniel Dennett's multiple drafts theory.[7] I've long liked Dennett's dangerous idea because it explains why we are rarely misled by words that have multiple meanings even when the correct meaning is not clear until later in the sentence (jokes are a deliberate exception). According to the theory of multiple drafts, we process all the meanings simultaneously. Eventually one of the resultant 'drafts' has enough information to become the manuscript of understanding. The template metaphor keeps the multiple simultaneous processing part of Dennett's theory and adds the idea that the templates are already there. We are not drafting meaning from scratch each time, we are attempting to match to previously learned schema.[8] This would explain how experts can analyse a scene so quickly – they are re-cognising it.

Note, n this model, information is not 'filtered out' to prevent overwhelm as is commonly suggested – instead it is 'selected for salience'.[9] Salience refers to those features which have proven useful to notice in the past and therefore 'stand out' from the rest of the context. Why do they standout? Because we already have a template for them!

Do we really 'make' or 'take' decisions'?

I am now going to go off on a side-shoot about how we conceive of 'making a decision' (or as some Brits like to say, 'taking a decision').

It is interesting to note that Harré's research isn't focussing on what we would typically think of as the decision-making process. It is attempting to understand how we make sense of what happens *before we decide* to embark on an action.

The standard cognitive model of decision-making is:

Input >> process >> decision >> behaviour

Everything between the input and the behaviour cannot be directly observed by an observer – and this mostly includes the decision-maker too. From an outside view it seems that at some point a decision is made and then acted upon. But I have a hunch that most of the time people don't make decisions like that. Rather, *afterwards,* the change in behaviour leads us to assume that something was decided *at some moment* prior to the new behaviour.

It seems self-evident that there is a *before* the decision and an *after* the decision – but is there? How much of that is our tendency, as Gregory Bateson pointed out, to "punctuate" the continuous flow of experience into beginnings, middles and ends, and neat linear strategies? A complicating factor arises because the decider not only has direct access to some their internal processing, they can also take a meta-position as if they were an outside observer. This perspective, too, is prey to the same desire to punctuate. Given that we are predisposed to think in this way, it means not all templates are equal, some that we have used successfully before get preferential treatment – and that makes it hard to think outside the template.

If we ask, *when precisely* was a decision made, we run into a difficulty. Was it made when the decider noticed the signals that let them know they had made a decision? (Remember that your body is a context too!) We all know of situations where 'decisions' are taken but not acted upon – so, did we *really* make a decision? And what about the situations where we make a decision and then change our mind. Which was 'the' decision?

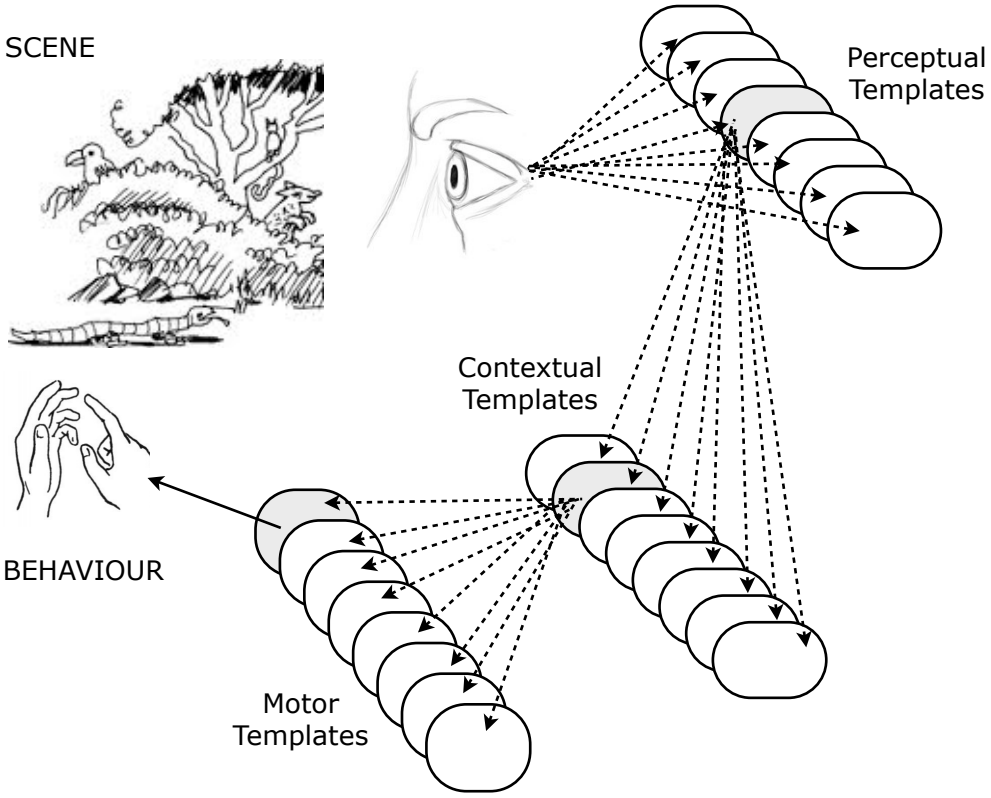
Or consider those times when we have decided to do something and in the act of doing what we decided we unexpectedly do something else. James Hillman tells a lovely story in the *Soul's Code.* It Is:

> Amateur Night at the Harlem Opera House. A skinny, awkward sixteen-year-old goes fearfully onstage. She is announced to the crowd: "The next contestant is a young lady named Ella Fitzgerald. ... Miss Fitzgerald here is gonna dance for us. ... Hold it, hold it. Now what's your problem, honey? . . . Correction, folks. Miss Fitzgerald has changed her mind. She's not gonna dance, she's gonna sing ...

Ella Fitzgerald gave three encores and won first prize. However, "she had meant to dance." What decision was made when?

Over the last twenty years I have had plenty of opportunity to model my clients' decision-making strategies. Their dilemmas are 'complex' because there are no easy solutions and they potentially have great ramifications. I've watched how they struggle to 'make' a decision and investigated after the event how the decision was arrived at. Rather than a decision being taken more or less consciously at a moment in time, the process seems more like a continuous 'slider' that starts with a trigger and ends with behaviour. The decision-making doesn't happen at any point. Either there are many mini-decisions, or there is a continuous flow of processing which leads to a new perception and new behaviour. I favour the latter idea.

Penny Tompkins pointed out that my slider is itself part of larger context of trial-and-feedback, commonly known as learning. Thus is could be context analysis all the way up the cognitive hierarchy. What if, *during* the context analysis, multiple motor templates are simultaneously passed cues to be matched or mismatched? Each template could accumulate cues until one of them has seen enough to trigger al behaviour (see diagram below).



We seem to accept this for 'instinctive' behaviours, e.g. someone unexpectedly throws a ball at you, do you *decide* to catch it – if so, at what point? I suggest 'the decision' is smeared across time from the moment we first see the ball to the moment it is in our hands. With more complex decisions we think that something extra has to happen.

Clients who come to therapy in a dilemma about a decision often have been waiting, sometimes for years, for something to happen which means they 'know' the 'right' decision to take. But many decisions, especially ones with an ethical component are not amenable to this kind of thinking – neither choice is 'right' and both are 'wrong' depending on your viewpoint. However, while the uncertainty persists, it is a challenge for some people to change behaviour because that involves making a decision. Can you see the bind this creates? What often happens is they eventually 'find' something that justifies them doing one thing or the other.

To end on an encouraging note, Michael Harré said that "Expertise expands without bounds as far as we are aware." It seems people don't reach a capacity, they simply stop when they have enough.

NOTES

[1] My thanks to Susie Linder-Pelz for taking Penny and I to the lecture on 13 Mar 2012. Harré has the intriguing title of Principle Investigator at Large, Centre for the Mind, Faculty of Science, and his work is funded by the U.S. Air Force.

[2] The next time you hear someone make a generalisation about behaviour from neuronal research, remember Harré's words.

[3] My guess is that the difference is partly due top experts thinking systemically rather than linearly.

[4] Although Harré didn't mention it, 'context' is itself multi-layered. He mostly referred to the physical context. On top of that are many layers of social context. Think of how decision making is affected when preparing for the final hole of The Open golf tournament.

[5] At a higher level I think this is analogous to 'confirmation bias' and 'the illusion of validity' – once we have jumped on to the island of conclusion we unconsciously favour information that supports our conclusions. *And* even when we know about confirmation bias we don't think it applies to us! See my blog on Daniel Kahneman's work: cleanlanguage.co.uk/articles/blogs/61/

[6] For an appreciation of this influential theory, download Paul Tosey's paper, 'Bateson's Levels Of Learning: a Framework For Transformative Learning?' at: www.som.surrey.ac.uk/NLP/Resources/BatesonLevels2006.pdf

[7] For a summary of Daniel Dennett's Multiple Drafts theory see our 'Self-Nudging: unconscious decision-making and how we can bias our future self' at: www.cleanlanguage.co.uk/articles/articles/312/

For a description of what Cognitive Linguists call 'image schema' and how they apply to modelling metaphors see our article, 'Embodied Schema: The basis of Embodied Cognition' at: cleanlanguage.co.uk/articles/articles/245/

[8] If I understood him, for *implicit* learning to take place Harré said we need: constancy, regularity, co-occurrence, and accurate feedback, all at multiple-levels. For more on 'Feedback Loops' see our article at: cleanlanguage.co.uk/articles/articles/227/

[9] For more on selecting for salience see our articles 'The Neurobiology of Space', www.cleanlanguage.co.uk/articles/articles/196/ and 'Attending to Salience', cleanlanguage.co.uk/articles/articles/234/