Satisficing and Cognition:

Complementarities Between Simon and Hayek

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Abstract

Herbert Simon's view of decision making as a satisficing process has typically been applied in relation to understanding limits to the extent of search that people undertake. In this paper, by contrast, the focus is on the need for the processes of cognition, that Hayek sought to understand in *The Sensory Order*, to employ satisficing mechanisms in order for lightning-fast judgments to be made about incoming sets of stimuli. The paper also argues that hierarchical decomposition facilitates the processes by which the mind finds matches between stored sets of neural connections and sets activated by incoming stimuli: by first assessing the context at hand, the mind can rapidly compress the set of stored patterns within which an acceptable match may be found. After considering how the paper's view of the role of context complements the role assigned to context in both 'old' and 'new' behavioural economics, the paper uses Hayek's analysis to considers how sets of stimuli that were once shocking can come to be construed as acceptable (and, sometimes, vice-versa) and the processes by which aspirations adjust.

Introduction

Economists habitually construct models of choice that implicitly proceed as if the decision maker has already made three other kinds of choice:

(a) How to construe the problem that the decision-making process is trying to solve;

(b) The set of potential strategies for solving the problem that has been identified; and

(c) How to construe the problem-solving potential of the rival strategies between which the choice is to be made.

By skipping these three stages, mainstream economists end up portraying the act of taking a decision as an instantaneous exercise in calculation rather than as a process of making up one's mind. This is a very truncated view compared with that which John Dewey (1910) offered with his notion of a 'decision cycle' in which stages (a), (b) and (c) precede (d) *choice*, after which (e) attempts are made at *implementation* (which may prove impossible) and there is later (f) a *hindsight review* of the results achieved as a consequence of the choice that was made.

The decision cycle notion was widely employed in the analysis of consumer behaviour in marketing (Engel, Blackwell and Kollat, 1978) and in what Sent (2004) has labelled 'old behavioural economics' (for a particularly useful discussion, see Loasby, 1976). However, it has received little attention from the 'new behavioural economists' who seem to view choice merely as entailing a somewhat twisted version of constrained optimization. Central to old

behavioural economics is Herbert Simon's (1957) analysis of choice as a satisficing process. In terms of Dewey's decision cycle, Simon's analysis deals with stage (a) as the identification or expectation of a gap between aspirations and attainments. It then goes on to integrate stages (b) and (d) by suggesting, in its simplest form, that the decision-maker keeps searching for alternatives until a strategy that seems acceptable as a means of solving the problem is discovered. In more sophisticated versions the stopping rule may entail limited further search to proceed after a potentially satisfactory solution has been found, in order to avoid needlessly poor attainments due to having been insufficiently ambitious in setting aspirations. Satisficing models show how choices can be made without a pre-defined set of alternatives and without somehow assuming, as Stigler (1961) did, that the decision maker can judge the marginal costs and benefits to further search. However, they typically do not address (c), the question of how decision makers arrive at cognitive judgments about what to expect from the options they discover. If they cannot characterize their options, they will have to get by with the aid of simple decision rules, such as trusting a particular brand owner to know what customers will find useful and to deliver whatever this might be.

Hayek's (1952) book *The Sensory Order* seems a promising starting point for analyzing the processes by which decision makers classify possible strategies and thereby decide what to expect. However, if the mind is in effect choosing what to make of sets of incoming stimuli, there needs to be some kind of theory of choice embedded in Hayek's analysis to determine which of the potential ways of categorizing a set of stimuli should be accepted. If such a theory is indeed embedded in *The Sensory Order*, then logically it might be something that can be

used to explain, in neurological terms, how choices are made in other parts of a decision cycle.

In this paper I argue that the process of cognition that Hayek proposes complements Simon's satisficing view of choice. My contention is that by bringing Hayek and Simon together we have a way of making sense of all the different kinds of choices that may be made in the process of taking a decision. Whereas the notion of satisficing is normally seen as a way of understanding how much information is gathered and what brings a decision to its conclusion, the argument here is that it also applies to the way that information is processed to form cognitions. Having extended the idea of satisficing to cognition by likening the brain to an Internet search engine, I explore the role that hierarchical decomposition—another of Simon's favourite concepts—plays in the process of cognitive simplification by framing incoming stimuli within a context. The significance of this view of context is shown to be rather broader than (but compatible with) the role context plays in both old and new behavioural economics. The rest of the paper then focuses on the potential for Hayek's analysis to help us understand how decision makers try to make sense of novel kinds of stimuli and its implications for understanding the process by which people adjust their aspirations. First, though, it is necessary to consider the case for taking a satisficing view of choice.

Satisficing

There are two ways of arguing the case that choice is a satisficing process and both are relevant when reflecting on *The Sensory Order*. Simon's (1957) 'bounded rationality' perspective focuses on the limited processing capacity of

the human mind relative to the scale of the puzzles with which it has to contend. A more fundamental case is made by Winter (1964) and Elster (1984, p. 135): optimization is impossible where decision problems do not involve choosing between a pre-specified set of alternatives, since it logically entails a problem of infinite regress as regards the question of how far to keep searching for better solutions. From the latter perspective, then, the cognitive issue is not the possibility of information overload relative to the time available to reach a decision but that, even if there were no shortage of processing power, attempts to compute an optimal choice would cause the system to crash. In simple terms, anyone who seriously tries to work out an optimal solution to an open-ended problem will find that it 'drives them crazy' and they are eventually forced to cut the process off by selecting an option that they can at least categorize as 'satisfactory'.

If choices have to involve satisficing, they are based upon processes that can divide alternatives into two piles: acceptable and unacceptable. Since Hayek's *Sensory Order* is a work that views cognition in terms of neural processes by which sets of stimuli get categorized, it seems a natural complement to the satisficing idea. But the complementarity works two ways: the brain has to operate in a manner that makes its categorization processes avoid the madness of trying to figure out the optimal categories to assign sets of stimuli. The categorization process runs into the satisficing issue for two reasons. The first is that there may be uncertainty about what actually constitutes the set of incoming stimuli because they emanate from a noisy environment or because one's senses are impaired. The second issue is that the

range of interpretations that might be applied to any set of stimuli, clear or fuzzy, is potentially enormous.

We can get a sense of the second issue and the importance of choosing appropriate categorizations via some examples from famous works in arts and entertainment that employ unexpected but appealing categorizations (as in poetry) or surreal categorizations (as in comedy). Lovers who can match the poetry of, say, the song 'All the things you are' by Jerome Kern and Oscar Hammerstein II, or Sonnet 18 by William Shakespeare (where he asks, 'Shall I compare thee to a summer's day?') and come up with flattering metaphors to characterize those to whom they are attracted will enhance their own attractiveness. However, having poetic ability will only confer an evolutionary advantage if this ability is uncommon or most people do not have time to deploy it.

The evolutionary advantages of being able to create and justify novel categorizations and the hazards of making tenuous associations that flouts social norms can be seen as being entertainingly demonstrated in 'The Oscar Wilde Sketch' from episode 39 of the classic 1970s TV comedy series Monty Python's Flying Circus. This sketch is set in Wilde's drawing room, where Shaw, Wilde and Whistler compete to see who can get away with the most outrageous way of characterizing Wilde's guest of honour, the Prince. His Majesty is thereby successively likened to a large jam doughnut with cream on top, a stream of bat's piss and a dose of clap. They blame each other for these attributions, forcing some quick-witted thinking to find ruses for explaining them away in a manner that the Prince will take as a compliment.

Although well-sponsored poets may consciously consider possible metaphors with no great urgency as they craft their verse, the process that Hayek describes normally takes place at very high speed and without people being conscious of them. Having a brain that can sort sets of stimuli into meaningful categories at lightning speed provides a competitive edge in the struggle for survival, both directly and by opening up space to reflect on wide range of possible interpretations of particular sets of stimuli and/or to imagine possibilities and considering how seriously to take them as solutions to particular problems. Evolutionary processes will therefore select the quick-witted. Although the extraordinary success of humankind in evolutionary terms owes much to superior human brainpower, the human brain nonetheless has severe limits on its processing capacity, as Simon emphasized. Because of this, the process that Hayek describes needs to take place in a manner that avoids wasteful neural activity but generates cognitions that are good enough for the context in question.

Cognition: the brain as a search engine

In Hayek's analysis, the neurological processes of the brain deal with sets of incoming stimuli rather in the way that an Internet search engine works when presented with a set of search words as stimuli. The brain sifts through stored sets of neural connections associated with previous acts of cognition, trying to find close matches between stored patterns and the pattern of neural impulses fired up by the incoming set of stimuli or possibilities being generated in the imagination. Where there are partial fits with several conflicting stored patterns the decision maker will perceive uncertainty and may experience feelings of

discomfort associated with cognitive dissonance. If so, the decision maker will either have to accept that a definite classification cannot be made (that is, accept the uncertainty), or find a way to remove the conflict.

Central to the problem of when to stop when forming cognitions is the fact that each set of stimuli that the brain receives is unique: even two physically identical products cannot occupy the same location at the same time. The match of a new set of stimuli with any stored pattern will thus only be partial, but a better (or even perfect) match may be achieved by simultaneously activating more than one stored set of connections. Without first trying a new combination of existing sets of connections for its fit with the set of stimuli, the quality of the fit cannot be known. Hence unless a perfect fit has already been found there is no obvious basis for saying whether or not further trials will improve the fit. In such case, the mind has to have a stopping rule based upon finding a fit that is in some sense 'good enough'. A simple unconscious process for specifying a good enough fit would entail checking whether there are enough matches between the set of neural connections being fired up by incoming stimuli and the stored set of neural connections that is being tested for fit. Another approach is to consider whether, in effect, the set of stimuli 'tick all the boxes' required to be admitted to a particular category, as in 'It waddles and quacks like a duck, so it must be a duck'.

If the brain treated all stored sets of neural connections as equally good potential matches to the set being fired up by the latest set of incoming, its finite processing speed would become an issue unless it happened swiftly to find a perfect match to a randomly-retrieved memory. If it failed to find a perfect match with a single stored set of neural connections and then moved on to considering

random combinations of stored sets of neural connections, it would have vastly multiplied the number of trial fits it might need to make before it hit on the perfect match.

The key to efficient brain functioning is that it does not involve random processing but is instead systematic and ideally operates in a parallel manner. If searching/matching proceeds randomly and sequentially, there is a very low probability that a good match between a stored set of neural connections and an incoming set will be found rapidly. What makes Monty Python's 'Oscar Wilde Sketch'—and Pythonesque humour generally—seem surreal is that it involves the juxtaposition of concepts that, as the expression goes, 'no one in their right mind' would normally see as going together, even as a first approximation. It is hard to imagine anyone viewing regal attributes as being like a jam doughnut unless they were on some kind of hallucinogenic trip in which their normal cognitive processes had been derailed, or unless they were 'trying to be clever' by deliberately looking for an improbable likeness.

Making rapid responses to the challenges of everyday environments will be impossible if our internal searching/matching processes get clogged up by trying potential fits without first selecting them on the basis of their probability of success. Our brains need to function somewhat like the Google search engine, whose success has come about because of its supposedly superior ability to rank its search findings in order of their likely usefulness. But even Google can be exasperating when it gets clogged with spam that has been designed to exploit its search algorithms. The latter phenomenon has led the search engine to be likened to a wide array of phenomena (see Friedman, 2011), with blogger Paul Kedrosky (2011) giving a surreal twist to Shakespeare in the title of a post he

wrote about how useless Google was at helping him to buy a new dishwasher, namely, 'Shall I compare thee to a snake, a gorilla, a jungle, bananas, sex…'.

In *The Sensory Order*, the mind is indeed portrayed as operating systematically in a manner akin to an Internet search engine. It is the stored sets of neural connections that have been activated most frequently in recent times that will initially tried for fit with the set fired up by an incoming set of stimuli. (Hayek's thinking is consistent with the empirical work on 'priming' surveyed in Kahneman, 2011.) Other things equal in terms of recent activation, a set of connections is more likely to be tried if it has a stronger history of cumulative activation. If a fit cannot be found, the mind tries patterns from further back in the memory, ranked in order of their cumulative past frequencies of being activated, or patterns that have been fired up recently but rank lower in frequency of recent activation than those initially tried. This can be viewed mathematically: we can imagine that the probability of any stored set of neural connections being tried for fit can be derived from a function that trades off its recent rate of activation and its cumulative rate of activation, with activations in previous periods being weighted less and less the further back in the past that they occurred.

Context and cognition

Having predispositions to check the match between incoming stimuli and particular stored sets of connections will only solve the cognition problem if the predispositions themselves are ones that have a good chance of generating workable matches with incoming stimuli sets. The probabilistic function outlined in the previous paragraph as a means of focusing the matching process might

work quite effectively for people whose lives involved only very limited range of choice environments but it seems likely to serve rather poorly anyone who needs to deal with very different environments in rapid succession. For example, if one works in a bakery it may not be dysfunctional to have a high probability of using the set of neural connections associated with a jam doughnut as a means for forming cognitions, for quite often it will give a good match (for example, when a customer is trying to point out which product they want to buy). Elsewhere, however, 'jam doughnut' will normally be about as helpful as trying to assess potential intelligence offices by asking them questions about cricket (as in another classic Monty Python sketch) because one happens to spend most of one's time thinking about cricket.

To deal with this, *The Sensory Order* needs another ingredient from Herbert Simon's work on bounded rationality, namely, the role of hierarchical decomposition as a means for coping with bounded rationality and enhancing evolutionary fitness in non-static environments (Simon, 1962). Hierarchical filtering processes enable us to avoid getting bogged down by the sheer range of possibilities and to reduce the risk of getting confused due to not being able to keep in mind the thoughts we have already had. The selection probability function thus needs to be separable, rather like the utility functions in the utility tree concept proposed by Strotz (1957). When shopping for a particular product, for example, we economize on search by first considering the kind of store in which we will find it and then, once at the store, in which section we will find it. Store managers simplify the process for us by systematically grouping products according to higher-level categories, much in the same way that librarians

catalogue books using hierarchical systems (see further, Earl and Wakeley, 2010a).

The search/matching process involved in cognition will thus function much more efficiently if our minds frame incoming stimuli sets in terms of an appropriate higher-level notion of context before trying to categorize them. For each context there may be a particular set of patterns of neural connections that could be tried for fit against incoming stimuli, with a selection probability function applying to the patterns in this set based on the recent and cumulative activation frequencies. Having made a high-level judgment about 'what situation are we in?', our minds can then seek to find matches between incoming sets of stimuli from elements of that situation and sets of stored neural connections previously activated in that kind of situation. For example, suppose we judge we are interviewing potential intelligence officers. If so, in trying to figure out whether they are worth hiring, we will not think about them in terms of their likeness to jam doughnuts or their interest in cricket even if, outside of our work environment, we do have penchants for jam doughnuts and cricket. Rather, we will be judging them in a similar way to how we operated when previously serving on that kind of interview panel.

Contextualization is a multi-level process. To continue with our example: a job interview itself takes place in a wider context that will affect the sets of stored connections members of the interview panel employ. As well as the organizational context there will be contextual issues such as the type and level of the position, whether there is more than one position, whether it is a new position or a vacated position, and so on, all of which will constrain the sets of stored connections that come to mind when forming impressions of the

suitability of the candidates. The more tightly specified the context, the more readily the mind can reach a verdict on how to classify a new set of stimuli.

Although it is necessary to frame phenomena within a context to deal with the problem of choice in the face of bounded rationality, erroneous judgments about which contextual frame is appropriate may result in dysfunctional outcomes because of the impact the chosen frame has on the sets of connections tried for fit with the stimuli being received. We look at the match of these stimuli with the stored patterns we have normally applied in that context and once the frame has been chosen it may not 'cross our minds' that sets of connections from other contexts might give a rather better fit. Furthermore, the context we assign may itself shape the set of questions we ask about the thing we are trying to categorize and hence the set of stimuli that we receive. Indeed, in some contexts, such as when looking at advertisements for real estate, the key to being able to figure out what one is looking at is the ability to deconstruct the situation by identifying the stimuli that one is *not* receiving and what their absence implies in terms of stored sets of connections.

Context and 'old' and 'new' approaches to behavioural economics

It will shortly be shown how context effects on cognition arise when decision makers encounter events that do not fit the frames of reference that they normally deploy to cope with the world around them. However, before this, it is worth exploring the relationship between the present view of context and the role played by context elsewhere in behavioural economics.

The role assigned to context differs sharply between 'old' and 'new' behavioural economics. In research in the tradition of Simon's satisficing/rule-

based view of decision-making, context shapes how choices are made via its impact on the decision maker's access to relevant information and ability to process it. If the set of options is small and the number of dimensions in which they differ is also small, it may be possible to rank them by trading off their various characteristics in a compensatory manner rather as in the optimizing model proposed by Lancaster (1966). However, if an overall value is to be computed in respect of characteristics that do not have a common unit of measurement, the puzzle is how the brain can decide what their ranking is and which, if any, are good enough. Possibly this might occur via a 'feel good' hormone such as dopamine being secreted when sets of neural connections are activated in the process of reflecting on the various prospective costs and benefits, with the amount of the secretion needing to pass a particular threshold to trigger a selection.

If decision-makers are instead presented with a huge range of choice, the message from the 'old' behavioural perspective is that they tend to switch into a non-compensatory mode, using checklists of aspirations, ranked in order of priority to filter out unacceptable options without computing any overall rating for each option (for example, Payne, 1976; Campbell, 1988; Payne, Bettman and Johnson, 1993; Norman *et al*., 2004; Lenton and Stewart, 2008). In these cases, compensatory processing is only to be expected if the initial non-compensatory phase fails to result in just one acceptable strategy but does at least filter out enough of the contenders to leave a workable 'short list'. The use of non-compensatory decision making modes fits well with a satisficing interpretation of *The Sensory Order*: we can think of a checklist in terms of a set of sets of stored neural connections that have the biggest probabilities of being activated in the

context in question, with that set being limited in size by the information processing load that is present.

Where the context of choice involves the absence of information that the decision maker would like to have—as with experience goods and credence goods, or when the consumer is choosing among search goods but is simply too busy to gather information that is, in principle, available—it may be impossible to employ decision rules based around the fit between product attributes and aspiration levels. The decision maker therefore is driven to use proxies for quality, such as the reputation of the supplier or familiarity with the brand. This, too, is consistent with *The Sensory Order*, for a reputation must be associated with the frequent activation of a particular neural connection set: a single case of approval will not make the supplier stand out unless it is associated with a frequently activated set of connections, such as those concerning a friend 'who always knows which suppliers are trustworthy'. The more frequently stimuli associated with a brand have been encountered in a particular context, the bigger is the probability that this brand will come to mind as a potential solution to the problem at hand (see further, the penultimate section of this paper).

'New' behavioural economists, by contrast, follow the lead of Thaler (1980) and focus on context effects in relation to a variety of heuristics and biases and the construing of gains and losses relative to a reference point (as in Prospect Theory). There is scope for an entire paper to be written on how these kinds of effects could be driven by the cognitive processes that Hayek envisaged. Here I only have space for a few examples. First, availability bias is to be expected in terms of the higher probability of recently activated sets of connections being tried for fit with those activated by a fresh set of stimuli.

Secondly, we might expect sunk cost bias to decay through time (as is implied in Wolf, 1970), as the sets of connections activated in respect of a past commitment get crowded out by those associated with more recent acts and experiences—at least, so long as onlookers do not continue to generate stimuli by suggesting that the commitments are mistaken and need to be abandoned. From a Hayekian standpoint, the more pressure there is to treat bygones as bygones and admit a mistake, the less likely it is that the decision maker will come round to that way of thinking, since the pressures is likely to re-activate the initial sets of connections the decision-maker associated with the project, such as those to do with a self-image as a competent decision maker.

The apparent tendency to think about choices involving risk or uncertainty in terms of prospective gains and losses relative to a reference point (which Prospect Theory shares with the 'potential surprise' model of choice under uncertainty proposed by Shackle, 1979) is much easier than the traditional expected utility theory value function to reconcile with Hayek's view of cognition. Each possible outcome along an axis will not have the same probability of coming to mind to try for fit against the stimuli associated with an uncertain scheme of action. Rather, the mind will be most likely first try those sets of connections that have been most frequently/recently activated in that context. These are likely to concern where the person is now or aspires to be.

Reactions to unfamiliar and novel situations

People differ greatly in how they react to unfamiliar forms of behaviour, products and technologies. Faced with a given set of novel stimuli, some people may be excited by the fresh opportunities that they perceive, while others may

act defensively and display Procrustean tendencies, trying to force-fit their interpretations of the significance of the stimuli into their existing view of the world rather than seeing them as implying any need or opportunity for change. Hayek's view of the mind can help us understand such differences in openness to novelty.

To make sense of novel sets of stimuli and be open to change, the mind has to be able to create new sets of neural connections. The process here is necessarily rather akin to what happens when an entrepreneur comes up with a new product: the product is not conjured up from nothing but by combining some existing concepts to generate something that has new or improved capabilities (Earl, 2003; see also Shackle, 1979, on the idea that the imagination conjures up new ideas from existing elements rather in the way that new words can be created from existing letters of the alphabet, and the discussion of 'associative memory' in Kahneman 2011). To develop a viable cordless phone, for example, it was necessary to bring together three concepts, each of which was itself a product of integrating existing technologies: telephone, radio, and rechargeable batteries. For the potential customer to appreciate the merits of a novel product it may not be necessary to see it as a conjunction of the existing technologies that the entrepreneur creatively combined, but to make sense of it will require figuring out what it 'is like' in relation to some existing personal sets of connections: in the case of a cordless phone, one consumer might, for example, see it as 'serving a similar purpose to a TV remote control handset', whereas another might see it as 'yet another unnecessary piece of technology that could prove confusing and prone to going wrong'.

One way of dealing with something unfamiliar is thus to accept it as such and try to make sense of it by seeing if the stimuli set associated with it will match up with a combination of stored sets of neural connections that previously have not regularly fired up together in that context. For example, if I am looking through a piece of 'junk mail' from a chain of retailers of electrical equipment to see what new products have appeared, my brain will give precedence to a particular set of 'electrical gizmo' templates for making sense of the information. I will waste my time if I try to make sense of a new 'smart TV' in terms of neural connections I might apply to 'soft furnishings' or 'food and drink'. If I simply stick with patterns I normally employ in the 'electrical store' context, I may swiftly be able say to myself 'OK, I get it: a "smart TV" is not merely a TV with WiFi to enable access to video files stored on computers or hard drives linked to my domestic WiFi network; it also means I can get direct access to downloadable context from the Internet'.

But we do not have to do this; instead, our sensory processes may prevent us from creating new sets of connections that other people are able to form. Two factors may be at play here. The first is that we may not have developed previously the concepts necessary for building a particular new concept. The chances of having sets of neural connections that can be combined to match the incoming set of stimuli will depend upon the range of events that the mind has been able to make some kind of sense of previously by constructing new sets of neural connections. For example, a toddler who has been playing in his mother's dressing room, unbeknownst to her, may emerge covered in lipstick and proudly say 'paint!' because he has previously seen objects being painted but has never seen his mother applying lipstick and has no concept of 'make-up'. He is open to

new concepts but this is the best he can currently do given his repertoire of existing sets of connections. Similarly, an adult who has not previously formed an understanding of 'WiFi' and 'the Internet' might have no idea about what makes a 'smart TV' different from a traditional TV and might go in a variety of directions in attempting to categorize it—from 'something I'll try to find out about when I'm next in an electrical appliance store' to 'yet another device to try to trick consumers into buying things they don't really need when their existing products are still functioning perfectly OK'.

Secondly, we may fail to try combining our previously formed particular sets of neural connections to make new ones because we jump to a conclusion about the nature of the unfamiliar set of stimuli on the basis of being able somehow to match it with existing patterns of neural connections that get the first shots at classifying the stimuli. Other, potentially more relevant sets of connections simply remain 'at the back of our mind' and will only get to the front of the queue for consideration if it proves too hard to get an acceptable fit by using the recently/frequently-deployed sets of connections. Erroneous inferences are likely if the promotional material for the unfamiliar product describes it in words commonly used in a different kind of context and thereby triggers an attempt to make sense of it from the standpoint of the familiar context. For example, even economics students may be prone to get misled by mobile phone contracts that focus on a monthly 'cap' payment with a much greater 'included value' amount: the tendency is to see 'cap' in relation to other contexts in which the term 'cap' is applied to mean an upper limit and hence to infer that the maximum monthly sum one will have to pay is the 'cap' amount, rather than seeing it as a 'price discrimination situation' in which the 'cap'

amount denotes the limit to services provided at a cheaper rate. (In these contracts, which have been particularly common in Australia, only one set of prices is actually specified and this is why the 'included value' figure exceeds the 'cap', with the ratio between the two implying the extent of discount on service until the included value has been used up.)

Creative thinking may, of course, differ between people due to differences in some underlying capacity or willingness to experiment with new combination of connections. But, aside from differences of imaginative capacity of this kind, the logic of *The Sensory Order* implies that those who operate in environments that are not normally characterized by novelty and differentiation will have trouble making sense of novel sets of stimuli: they will habitually form cognitions using a limit set of sets of neural connections and their repertoires of stored sets of connections that they can call upon will be small. By contrast, those who have to deal with environments that are rich in novelty and surprises will have large repertoires of stored sets of connections and will tend to use a wider range of these sets of connections in their everyday processes of cognition. The situation here may be likened to that of scholars trying to create knowledge by synthesizing ideas from their past reading. A scholar who has read only 100 works and tends to try to comprehend the world via his or her favourite dozen works will seem to engage in highly channelized thinking compared with someone who has read 200 works and calls upon as many as 40 of them quite frequently.

Given that cognitive processes work at a finite rate, it should normally pay to occupy the middle ground in terms of the size of the repertoire of sets of neural connections that come readily to mind due to frequently being activated.

However, survival opportunities will also be enhanced by having had a wide range of experiences and possessing a brain in which sets of connections that are infrequently called upon do not dissipate altogether. In terms of the analogy with scholarly behaviour, having just a single 'bible' will result in a gross lack of ability to create viable new perspectives but so, too, will being incredibly widely read whilst lacking any favourite sources. In the former case, it may be impossible to conjure up any new ideas whereas in the latter case it is akin to suffering hallucinations, with a very low probability that any randomly activated set (or random combination of stored sets) of connections will be useful for making sense of new sets of stimuli. To function well under time pressure, a person's imagination needs to be partly open but also partly closed so that it limits the amount of attention it gives to irrelevant or dysfunctional sets of possible connections.

The shock of the new

If the mind cannot create new patterns of neural connections to make sense of new situations, it must either process the set of novel stimuli as if it is congruent with an existing set (i.e., force-fitting in a Procrustean manner) or be unable to process the elements of the novel set into a set at all. Achieving congruence is possible in two ways. One is to deny there is anything novel; the other, as Thompson (1979) recognizes, is to assign it to some kind of category of 'rubbish', as something that is worthless, a waste of time, to be ignored, avoided or not emulated. The achieving of congruence is a cognitive end-result and the mind can then rest or take in other sets of stimuli. By contrast, in cases where the mind

is unable to process the set of stimuli the situation is rather like that in which a computer gets locked into a processing loop and freezes.

In evolutionary terms, it will be disastrous to have a mind that is unable to assign sets of incoming stimuli into *some* kind of cognitive category, for this would preclude actions that may be necessary to deal with the changing external environment. When a computer freezes, the operator intervenes, forcing it to quit the application that has got stuck or rebooting it altogether. Clearly, in a social world, an external jolt from others can get a person to 'come to their senses' and refocus on cognitive puzzles that they can actually process; indeed, others may help one make sense of the puzzling stimuli by adding stimuli of their own. However, since people may be caught alone or a collective paralysis could otherwise occur in the presence of a novel environmental challenge, they need to have internally hard-wired systems for stopping them from freezing and instead making them see it as a situation in which they must engage in fight or flight without further ado regarding figuring out the nature of the challenge. These inbuilt processes seem likely to be associated with hormonal secretions in the brain, rather as with the role that the secretion of dopamine seems to play in determining whether people afflicted with Parkinson's disease are able to act normally or become seemingly locked.

The world premiere of Igor Stravinsky's ballet *The Rite of Spring* in Paris in May 1913 can be construed as a striking illustration of how these survival systems can cause people to behave when they are not open to the extent of novelty they encounter. Stravinsky had recently won acceptance for his two earlier ballets, *The Firebird* (1910) and *Petrushka* (1911) and all the initial signs were that it was just another normal musical event, with familiar surroundings,

dress and ritual, so the audience would not have been expecting to have trouble processing what they were to hear. However, what started out with something akin to a folk tune being played softly on a bassoon swiftly and suddenly became dominated by relentless pulse of an unfamiliar dissonant chord overlain with turmoil in unusual rhythms and, later, even more dissonant brass. In this case, the 'shock of the new' (this phrase is the title of Robert Hughes's 1980 BBC documentary series on the history of modern art), did not result in a mass exodus ('flight') from the concert hall. Instead, there was a riot. In a sense, the audience literally went crazy and in the absence of a large animal to fight, as their hunter-gatherer ancestors might have faced, they screamed, threw things and started fighting with each other.

Extreme emotional reactions and Procrustean behaviour will be particularly likely in cases where cognitive processes have constructed highly complex systems of sets of connections, such that an attempt to construct anew set of neural connections generates an inconsistency with a related set, with attempts to resolve that problem by forming a further novel set leading to yet another inconsistency, and so on. If there are complex patterns of implications between sets of connections, the brain may run into trouble computing where a particular cognition will lead if it is adopted, much as when political analysts have trouble figuring out where an incipient revolutionary uprising might take a country if it gains hold. Just as those who take hallucinogenic substances may experience bizarre contortions of their imaginations, so in everyday life people with highly integrated cognitive systems may report that particular events 'really freaked (them) out' because their brains had trouble wrestling with what the incoming stimuli seemed to imply.

If the probability of our minds trying to match up a particular set of connections to an incoming set of stimuli is a function of how frequently the former set has been activated recently, it become easy to see how individuals and societies can 'get used to' particular kinds of behaviour, products and opportunities. Within a quarter of a century of its premiere, Stravinsky's *Rite of Spring* had become acceptable enough even for an extract from it to be used in Walt Disney's animated feature *Fantasia*: it had become familiar to music lovers via repeated performances and has been surpassed in its strangeness by atonal modernist works. People can now comfortably categorize it as music, having had time to develop an understanding of it—unlike those at its premiere who were trying to figure it out on the run and without having experienced anything like it. It not longer challenges their notion of music.

This process of tolerance adjusting into line with the extent of experience of what is one is being asked to tolerate is evident across a wide variety of contexts and overlaps with Herbert Simon's views about aspirations adjusting into line with attainments. The quiet, ordered world of middleclass provincial life a century or so ago, that was captured in novels such as E.M. Forster's *Howard's End* or Marcel Proust's *Remembrance of Times Past*, seems bizarrely oversensitive to certain kinds of events that we may take for granted today. Even half a century ago, observations of couples getting divorced or having children out of wedlock were shocking to many because they were uncommon, but the more frequent they became, the easier it became to see them as no great source of scandal. Likewise, cars that were initially shunned due to what was at the time deemed radical but ugly styling (aimed at improving aerodynamics or providing better impact protection to pedestrians) eventually came to be seen as quite

tame by virtue of increased familiarity and relative to how later stylists 'pushed the envelope' even further.

Brainwashing and reversions to conservatism

Hayek's view of the mind also provides a means for understanding how people who have grown accustomed to phenomena that once seemed radical and/or outrageous can revert to much more conservative ways of thinking if repeatedly exposed to conservative stimuli. These conservative sets of stimuli will be categorized with the aid of frequently activated existing sets of connections and then stored. For example, a person who has a penchant for Stravinsky's music will have no trouble classifying earlier kinds of music as 'music' rather than 'a cacophony/just a lot of noise'. However, these recently activated conservative stimuli sets have a good chance of being tried for fit against subsequent incoming stimuli sets, whether the latter are similar sets of stimuli or rather different sets that nonetheless fall into the same context. They thus become more entrenched in the memory and begin crowding out rival sets of connections that are becoming less and less frequently activated.

An extraordinary case of this, in the context of musical tastes, is provided by Walter Murch in a discussion with Jad Abumrad, Robert Krulwich and Jonah Lehrer (2011) about the making of *Radiolab*, an experimental New York radio series that seems far too radical for many who come across it. Their discussion begins with the *Rite of Spring* phenomenon as an extreme version of the kind of reaction that *Radiolab* is prone to generate, but Murch then reports what happened when he was working at now-defunct New York radio station WRVR

and was given the job of making a card catalogue of its mainly classical record collection.

Murch decided to teach himself some musical history by listening to records that he was cataloguing, beginning with several shelves of Gregorian chants. For two weeks, ten hours a day, he listened to nothing else. One day, before he had got beyond Gregorian chant, he had to rush upstairs to ask one of the sound engineers a question. When he opened the engineer's room, there was music playing, but for Murch it just sounded like a cacophony—so much so that he clapped his hands over his ears. What he had burst in upon was not a piece of contemporary music, nor even *The Rite of Spring*, but rather a work that modern ears would not normally hear as dissonant, namely, Bach's *St Matthew Passion*. The dissonance that he heard was only dissonance compared with the 15th- and 16th-century music in which he had immersed himself for the previous two weeks. In effect, Murch had shunted his memories of more modern music to the back of his mind and had given himself an overwhelming probability of trying to make sense of modern music with reference to his many stored patterns of connections associated with Gregorian chants.

A rather similar kind of shock would probably be experienced nowadays, by those who are in late middle age, on seeing documentary TV material from the late 1960s on student revolutionaries and the era of 'free love'. Though the material concerns events from their youth, they have subsequently lived through years of political conservatism from Thatcher and Reagan onwards and have grown used to the cautious sexual mores that emerged in response to the AIDS epidemic in the 1980s. The shock they are likely to feel would not be due to having completely forgotten the late 1960s lifestyle that they may at the time

have embraced with gusto. Rather, from Hayek's standpoint, it would arise because they have not lately had much occasion to activate the sets of neural connections that make up these memories.

Advertising's impact and the adjustment of aspirations

This paper's account of the systematic way in which cognitive processes work provides a ready means for understanding how advertising may affect consumer behaviour and the processes by which consumers adjust their aspirations. Advertisements that are noticed by a consumer constitute sets of stimuli for them to process. An advertisement may be analyzed in a variety of ways in terms of existing sets of neural connections, such as what its message is supposed to be, what product it is advertising, whether it is cleverly done and likely to be effective, and so on. The different dimensions of appraisal may involve activating patterns from a variety of contexts. Hence, even if the advertisement fails to be appreciated in the way that its creators intended, it may at the very least succeed in causing consumers to activate sets of connections formed previously when thinking about the product. Each time the advertising stimuli are received, the sets of connections relating to the product may be reactivated.

Frequent advertising of a particular product thus increases its chances of coming to mind in the context in which the consumer thinks of it, while reducing the chances of its rivals coming to mind. So long as the way the product has been categorized is conducive to it being purchased—for example, 'possibly my next car', rather than 'a car made by a company whose dealer franchises still seem to believe in using every "old trick in the book" to sell its cars and "rip off" its customers when servicing the cars they buy'—this crowding out process may be

very effective at increasing the probability of sales success even if potential customers do not change any other ways in which they categorize the product.

A similar kind of crowding out effect may underlie the processes by which consumers adjust their aspirations. A very simple case is where consumers use external reference standards to decide the performance levels they ought to be able to achieve in the context in question. In the case of car safety, for example, if most new cars are being advertised or reported as having a four-star safety rating, it will be a four-star safety rating that keeps coming to mind when consumers reflects on the safety of vehicles that they might buy, and those with only three-star safety ratings will have a low probability of coming to mind as 'safe'. However, if manufacturers increasingly are achieving five-star ratings, well-informed consumers will have been activating connection sets associated with five-star cars and will have an increasingly high probability of thinking about safe cars in terms of a five-star rating.

Albert Hirschman (1970) emphasizes that generally customers do not display hair-trigger responses when a supplier or something that they have purchased lets them down. He argues that instead of 'exit', they may register their disappointment via 'voice' and, for a time at least, display 'loyalty'. From the standpoint of *The Sensory Order* it is easy to appreciate why a single case of a product producing disappointment or falling behind comparable alternatives does not normally result in it being re-categorized from 'acceptable' to 'not good enough'. Typically, a single shortfall will only have a limited impact on the relative probability of the consumer seeking to match the product up with the 'not good enough' category next time they think about it. Such a thought will have to compete against positive thoughts associated with it on many previous

occasions. With further disappointing performances, however, there is a progressive increase in the relative probability of negative thoughts crossing the consumer's mind: in common parlance, it is 'nagging away' with its 'niggling' deficiencies. Loyalty thereby withers away.

For perceptions to change suddenly, the disappointment caused by an existing product must be dramatic—so vivid that the way it is seen blocks out all chances of it continuing to be seen as acceptable. Such a process can be usefully understood with reference to the literature in personal construct psychology (Kelly, 1955, 1963; Hinkle, 1965), which complements Hayek at many points (see Earl, 2010). Here, a person's system of thinking is seen in hierarchical terms with some changes in constructs consequently having chains of implications that threaten core constructs that are used as foundations for many other constructs. From this perspective, being let down by a product could result in an immediate judgment that it is unacceptable because the set of stimuli associated with the disappointing event were matched to a cascade of negative consequences beyond the context in which the product was normally construed (as in 'I can't possibly risk having it do that to me again—I could have been killed/maimed for life/completely humiliated, etc., when it…'). In other words, for a consumer suddenly re-categorize a product as unsatisfactory, its perceived shortcoming must have come as a shock.

If a new product is to become a new benchmark right from the time of its launch, it will need to do more than offer a strikingly better performance in any one area. Rather, to be a 'game changer', its advantages must come at no cost in terms of a non-price shortfall in any other area or through a higher price (see Earl and Wakeley, 2010b). This is because, if there are any downsides, existing

products will still 'come to mind' as contenders as consumers reflect on what is acceptable in the area in question. Indeed, from the standpoint of Hayek's analysis, we may expect that even products that offer better performance without any need to compromise elsewhere will take time to become the benchmark in the context in question: with existing sets of neural connections firmly established for analyzing the context, anything that does not fit because it goes beyond normal expectations will seem 'too good to be true' until evidence mounts in its favour, showing that 'in the real world' it does live up to its manufacturer's claims.

Conclusion

The core theme of this paper is that bounded rationality is an issue in the process of making judgments about how to categorize sets of incoming stimuli. This idea may initially seem overblown. Our brains seem to cope effortlessly with sizing up familiar objects and situations unless, say, we are badly myopic and find ourselves struggling, without our spectacles or contact lenses, to figure out what we are looking at. But lightning-fast cognition in familiar contexts is only possible if the brain's initial search for fit with existing stored sets of connections involves a strategy of assuming the context is indeed a familiar one and hence that it will be OK to engage in localized search for patterns that may fit: for example, when we open our wardrobes, we expect to see our clothes; we do not for a moment consider that we might, say, be about to enter Narnia.

Normally, contextualization serves decision makers well rather than leaving them flummoxed. It is with respect to unfamiliar situations that we get an easier sense of the challenge that the brain faces in forming cognitions and the

vital role not only of hierarchical contextualization but also of satisficing processes. For example, students who make poor contextualization choices in exams may fail to see the point of the questions they attempt, but those who are able to keep generating many possible interpretations of a question will fail to get started on constructing an answer unless they can swiftly settle on one contender and use that as a frame for their answer. Before we can take decisions—even decisions to outsource choice to other agent—we must first get to some kind of conclusion about the situation at hand. This will not be possible if there are no limits to what comes to mind; at some point, there is a need to 'jump to a conclusion' about the nature of the situation and proceed to action

Combining Hayek and Simon in the way proposed in this paper makes it hard to feel comfortable with economic analysis that assumes, without sounding any note of caution, that decision makers have given, static preference systems. As Hayek (1961) elsewhere emphasized, aside from a few basic needs, people do not have innate, absolute wants. What they aim to achieve depends on the interpretations they have made of their experiences in a particular socio-historical context, and on what they have made of stimuli they have picked up from suppliers that were trying to interest then in their products. Hence if advertising is something to be seen as socially undesirable rather an aid to forming aspirations and making choices, the issue must hinge on the unequal competitive strength of rival advertisers' in terms of their ability to bombard consumers with their messages. If the leading brands have greater power than charities to capture our attention, we are likely to end up creating firm sets of mental connections that result in us aspiring to consume at ever-higher levels,

rather than opting to give our discretionary funds to those who are having trouble meeting their basic needs.

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