How May National Culture Shape Public Policy? The Case of Energy Policy in China

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APPENDIX

A.1 Culture and cognition

This section presents the key scientific findings that underpin the entire analysis by summarising the arguments supporting the links between culture and cognition, drawing on, first, psychology and, second, on neuroscience and genetics. The field of psychology was the first to produce evidence for the variation of cognitive styles between cultures. More recent neuroscience studies have shown that such differences are reflected in brain activity. Genetic research has suggested that these differences may also be retained in genetic material. In other words, the cognitive processes applied by an individual or groups of individuals in solving problems may be shaped to a certain extent by long-lived features of societal culture.

A.1.1 How does culture shape cognition?

Many definitions of culture exist, but one that is appropriate for this analysis is the "causally distributed patterns of mental representations, their public expressions, and the resultant behaviours in given ecological contexts" (Medin et al., 2007). In other words, culture links the mind with language, action and

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environment. Culture is transmitted across a society and across generations principally through imitation and teaching, with language playing a central role. Such social learning is based on belief rather more than on analysis and understanding, and the resultant shared normative behaviours enhance societal cohesion (Bender and Beller, 2019).

This account follows Bender and Beller's (2013) explanation of cognition as involving a range of mental processes such as perception, attention, categorisation, learning and memory, thinking, problem solving and decision-making, and use of language. Many factors can influence an individual's cognitive processes in addition to culture. These include physical environment, social context, life experience, training and profession (Levinson, 2012; Fanta-Vagenshtein, 2013; Bender and Beller, 2013; Simons et al., 2020). In this analysis, the focus is on the role that culture plays in shaping cognition.

Two important carriers of culture that shape cognition in day-to-day life are artefacts and social practices (Fessler and Machery, 2012). Artefacts are representations or tools designed to aid cognitive processes that embody a theory of use in a certain context (Norman, 1991). Examples include diagrams, maps, writing and numbers (Bender and Beller, 2013). Many such artefacts may be long-lived and widespread across a society. Of these, language is arguably the most important. For example, the Chinese ideographic or, strictly speaking, logographic written text and tonal speech contrasts with the phonological alphabet and atonal speech of the English language. Arabic, Chinese and Roman numerals are also quite different from each other. In addition to the use of artefacts, an individual will also learn from the habits and practices of the society or group within which they live, as well as through formal education, as discussed above (Bender and Beller, 2013).

Culture affects cognition in two main fields: perception and categorization, and explanatory frameworks and problem solving (Ji and Yap,

2016; Bender and Beller, 2016). Culture, including language, shapes how individuals perceive and categorise everyday phenomena such as numbers, colours, time, space and music. It also guides what individuals pay attention to (Norenzayan et al., 2007; Bender and Beller, 2016). Culture, along with training, expertise and life experience, is one of the factors affecting reasoning and causal explanation. Traditional societies tend to apply concrete or intuitive reasoning based on experience. More sophisticated societies, especially those with a western cultural heritage, are more likely to apply formal logic and display a strong tendency to distinguish between right and wrong solutions to problems. In identifying causes, they are also more likely to focus on the role of specific actors. In contrast, other societies, such as Chinese, may apply more holistic thinking, assess the wider context and accept contradiction and ambiguity (Norenzayan et al., 2007; Bender and Beller, 2019). The caveat that applies to all such generalisations is that they have greater explanatory power at the group or societal level than for individuals (Ji and Yap, 2016).

A.1.2 Insights from neuroscience and genetics

Progress in the fields of neuroscience and genetics has been steadily revealing how culture can affect cognition and how culture and genes may co-evolve.

Technological advances in neuroscience have allowed researchers to investigate the links between culture and cognition. This has led to a new field of research, "cultural neuroscience". Cultural neuroscience brings together cultural psychology and neuroscience (Han et al., 2013). It has become clear that the human brain is highly plastic and that sustained use of certain cognitive tools rewires the brain. This rewiring draws on the interaction between the brain, the individual's perceptions and the environment. Thus, extensive training in such activities as writing and musicianship change the cognitive system of an

individual. Cultural influences may also result in rewiring (Wilson, 2015). Thus, whilst some neural processes are universal, others are culturally specific. In different cultures, the same task may use either different parts of the brain or the same part of the brain with different intensity (Northoff, 2016). Cultural differences detectable in brain function include understanding of self, language, numbers, the organisation of information, visual perception and attention, and reaction to incongruence.

Richerson and Boyd (2005) explained how cultures evolve through a combination of social learning and imitation in response to changes in the environment. Though not drawing on hard genetic data, they also argued that genes and cultures co-evolve; the so-called "dual inheritance theory" (Kim and Sasaki, 2014). Key evidence for the dual inheritance theory lies in the study of epigenetics. Epigenetic changes take place in response to changes in the environment and are triggered by the central nervous system. Such changes can involve morphology, physiology, behaviour and life history. They are not reflected in changes to the genes and are reversible. Rather, epigenetic changes involve variations in the intensity with which individual genes are expressed. In simple terms, genes can be turned on or off. Such changes are quite different from genetic changes which are more random and may not be advantageous (Cabej, 2011). Evidence in support of adaptive epigenetic inheritance is growing and it is becoming apparent that sustained epigenetic adaptations may result in genetic change (Lind and Spagopoulou, 2018).

The significance of these developments in neuroscience and genetics is two-fold. First, cultural differences are reflected in how the brain works. In other words, societies from different cultures are likely to think and act in different ways in a range of settings. In the context of this paper, they may solve problems in distinctive ways. Such variations are more strongly expressed at the level of the group than of the individual. Second, culture and genes co-evolve. Some

elements of a contemporary culture may have deep historical roots and be embedded in genetic information. Thus, history is important. The implication for public policy is that the way in which policy actors identify, analyse and resolve policy challenges may vary between cultures. Further, such cognitive differences may change only slowly and may not converge to some universal norm.

A.2 Distinctive features of East Asian and Chinese cognitive styles

Having set out the general scientific evidence for the links between culture and cognition, we now move on examine the evidence for the distinctive nature of cognition in Chinese culture. Unfortunately, some of these studies drew on individuals from other East Asian cultures, notable Korean and Japanese, which detracts from the focus on Chinese culture. Nevertheless, we shall assume that the Confucian and Daoist heritages across these nations are sufficiently similar that the line of arguments is not critically undermined.

The largest literature on comparative culture and cognition focuses on the contrasts between the societies of East Asia, especially those with a Confucian and Daoist heritage, and Western societies with a Greek philosophical tradition. As mentioned above, one of the pioneers who pursued this line of enquiry through experimental psychology was Richard E. Nisbett with colleagues at Michigan University (eg, Peng and Nisbett, 1999). Their central message was that the collective societies of East Asia displayed thinking that was more holistic, whereas Western societies were more individualistic and analytical (Nisbett et al., 2001). Over the succeeding twenty years, a growing number of scholars from different disciplines have tested and developed these findings, including with other societies. For example, the differences between East Asian and Western cognition have been correlated with both genetic characteristics (Koo et al., 2018) and brain function (Cheon et al., 2018). As a

result, the credibility of the findings related to contrasting cognitive styles has steadily increased.

Drawing on traditions that date back more than 2,000 years, East Asian societies pay more attention to context than to specific objects and they apply more holistic thinking. When observing physical phenomena or making decisions, the individual is more likely to take into account the wider context and relational issues rather than focus on a specific prominent issue, object or person (Nisbett et al., 2001; Norenzayan et al., 2007; Ji and Yap 2016; Koo et al., 2018). Holistic thinking results in an approach to categorisation that draws on analogy or relationship, rather than on rules. This in turn leads to a strong reliance on metaphor to provide insight. The consequence is ambiguity, but this provides scope for interpretation (Li, 2018). Neuroscience studies of Westerners and East Asians have revealed that individuals from the two cultures use different parts of the brain when organising information and that neural activity increases when using a culturally unfamiliar method (Gutchess et al., 2010). The same applies to assigning causality. Here, the East Asian may draw on a large number of variables and invoke a weaker link between cause and effect (Spencer-Rodgers et al., 2018; Koo et al., 2018). Han et al. (2011) have shown that Chinese and North Americans use different parts of the brain when assigning causality to visual stimuli.

A core component of East Asian epistemology is dialectical thinking following the Dao traditional belief in yin-yang balancing (Li, 2018). At the heart of this philosophy is the belief that all phenomena are interconnected in a vast complex. Further, opposing elements are at the same time contradictory and complementary, and can transform into each other under certain conditions. The consequences are a tolerance of contradiction, a reluctance to judge by appearances, an expectation of continuous change, and of ambiguity and uncertainty, and a greater use of intuitive reasoning than is displayed by linear

Western logic that assumes an objective and knowable reality (Spencer-Rodgers et al., 2018). Laboratory studies have shown that the brain responses of the East Asians were greater when faced with visual or vocal incongruence than that of Westerners. This is interpreted as reflecting the greater effort expended by the East Asian subjects when reconciling the incongruence (Ishii et al., 2010; Goto et al., 2013)

In the case of China, these cognitive features are enhanced by the language, which is strong on images and metaphors but weak in conceptualisation (Li, 2018; Koo et al., 2018). Different languages, whether spoken or written, require different cognitive processes and activity in different parts of the brain (Levinson, 2012) and may result in different brain structure (Kim and Sasaki, 2014). The contrast between an ideographic or logographic written language such as Chinese and a phonographic one like English is particularly strong (Bjornsdottir and Rule, 2017). This difference is also reflected in how cultures with these two languages solve mathematical problems (Kim and Sasaki, 2014).

As mentioned above, education plays a strong role in sustaining cultural traditions, and the style of education is shaped, in turn, by cultural tradition. Whilst the true nature of original Confucian teaching can be debated (Deng, 2011), pedagogy in China has been largely teacher-led for centuries and such practices can be seen in schools today. Key components include an emphasis on moral education including affection for the nation, the state and the Communist Party, the importance of teachers and other individuals as exemplars, rote learning and ritual recitation in class, and the role of formal examinations to test recall of key ideas and information (Wu, 2016). Under the leadership of the Communist Party, political and ideological education remains important, though the balance with technical and academic education has varied over time (Zou, 1985; Shen, 1994; Law, 2014).

Whilst, these observations do not negate the existence of a degree, possibly substantial, of universality in human cognition, they do support the idea that East Asian cultures, including Chinese culture, have distinctive cognitive attributes, at least at the group level. Some of these differences have deep historical roots as comparative studies of ancient Greek and Chinese science and philosophy have shown.

The Greeks and Chinese possessed quite different philosophies with respect to metaphysics and epistemology. The Greeks believed in the existence of a knowable reality and of a mechanistic universe governed by fixed rules (Yu, 2015; Mokyr, 2017). In ancient China, the yin-yang belief, described above, led to quite a different understanding of the world as being complex and interconnected. As a result, reality was seen as being relative and open to interpretation (Lloyd, 2004; Wang, 2015; Rosker, 2018).

These contrasting metaphysical outlooks led to differences in epistemological approach. The Greeks preferred deductive reasoning, building on axioms to produce models of reality and incontrovertible proofs. The aim was to explain objects or phenomena, and to identify cause and effect (Lloyd, 1996, 2004). Opposites were independent and in contradiction to each other (Lloyd, 2015). Chinese enquiry was more intuitive, drawing on analogies and seeking correlations. It was directed more at understanding processes and the relationships between objects (Lloyd, 2004; Rosker, 2014, 2018). Contradictions were accepted and seen as interdependent (Lloyd, 1996). Whilst the Chinese did deploy deduction as a form of reasoning, they tended to avoid the formulation of axioms and did not seek incontrovertible proofs (Lloyd, 1996, 2015).

One other aspect of Chinese science was the context in which it took place. This takes us to the "Needham question" was why modern science had not developed in China, except through recent import; or more fully, why was Chinese civilisation so far ahead of other civilisations for more than 1500 years,

having developed many sophisticated technologies centuries ahead of Europe until the 15th century, after which the Renaissance triggered an acceleration in the development of science in Europe, but not in China or major civilisations (Needham, 1969)? Several factors were at play, beyond the contrasting metaphysical outlooks just mentioned. Of particular importance was the role of the civil service examinations in imperial China. These traditionally required rote learning of the classics and a skill at essay writing (Elman, 2013), rather than a penchant for discovery and innovation (He, 2008). Whilst practical knowledge was not a prominent prerequisite (Needham, 1969; Lin, 1995), the syllabus did at times include topics such as law, taxation, astronomy, mathematics and politics (He, 2008; Elman, 2013). Elman (2013) argued that the role of the examination system was to ensure the reproduction of China's political, social and cultural traditions and thus support the imperial system. The principal role of the Chinese scholar-official was to advise the ruler, rather than prove a point in public, as was the case in ancient Greece. Today's intellectual environment is not too dissimilar. As Xi Jinping increases Party control over the universities and think tanks, it has become risky for intellectuals to criticise rather than support government policy (Li, 2017; Minzner, 2019).

This section has shown that East Asian, and particularly Chinese, cognitive styles have certain distinctive features that are rooted in ancient philosophical beliefs. Notable is a more holistic rather than analytical approach to problem solving that is more open to ambiguity and contradiction, and makes less use of axioms and theoretical models the very features noted above in section 2 of the main text of this paper..

Two caveats are in order. First the laboratory work has necessarily been restricted to a limited number of individuals and therefore the scalability of the results to whole populations can be challenged. Second, as explained in section A.1 of this Appendix, an individual's cognitive processes can be shaped not just

by their cultural background but also by their physical environment, social context, life experience, training and profession. Thus, when an individual from one culture moves to a society with a different culture, the individual is likely to be affected to a greater or lesser extent by the new culture. In this case, their cognitive processes may undergo some change. Likewise ideas from one culture may flow into and influence another culture.