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Culture Embrained: Going Beyond the Nature-Nurture Dichotomy

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Abstract

Over the past three decades, the cultural psychology literature has established that there is systematic cultural variation in the nature of agency in the domains of cognition, emotion, and motivation. This literature adopted both self-report and performance-based (or behavioral) indicators of these processes, which set the stage for a more recent systematic exploration of cultural influences at the neural and biological level. Moreover, previous work has largely focused on East-West differences, thereby calling for a systematic exploration of other ethnic groups. To address these issues, this article reviews recent work in cultural neuroscience, while paying close attention to Latino Americans—the single most rapidly growing minority group in the United States. We focus on research that has employed neural measures and show that culture has systematic influences on the brain. We also point out that, unlike more traditional self-report or performance-based measures, neural indicators of culture are reliably linked to theoretically relevant individual difference variables such as self-construal and acculturation. Cultural neuroscience offers the framework to go beyond the dichotomy between nature and nurture and to explore how they may dynamically interact.

Keywords

culture, diversity, neuroscience, nature, nurture

The human brain has fascinated scientists for centuries. For example, Santiago Ramón y Cajal, a pioneer in neuroscience at the turn of the 20th century, viewed the human brain as a world consisting of a number of unexplored continents and great stretches of unknown territory. Since Cajal's time, our understanding of the brain has grown, starting with the testing of animal models, and expanding to the study of humans. These explorations lead to tremendous advances in understanding human cognition, emotion, and motivation. Within them, however, lay an implicit assumption that the brain is a stable body of matter universally the same across cultures. Through research showing the plasticity of neurons, this assumption was challenged and simultaneously gave a venue for the study of the reciprocal influence of culture and the brain. Instead of seeing nature and nurture as a dichotomy, cultural neuroscience has proposed an alternative view that the human mind as biologically prepared and yet transformed through active participation and engagement in culture (Kitayama & Park, 2010; Kitayama & Uskul, 2011; Kitayama, Varnum, & Salvador, in press).

The past three decades of research in cultural psychology demonstrated that culture, defined as a system of values, beliefs, and practices, powerfully influences multiple layers of the human mind (Gelfand et al., 2011; Greenfield, Keller, Fuligni, & Maynard, 2003; Heine, 2015; Henrich, 2015; Kitayama & Uskul, 2011; Markus & Kitayama, 1991; Nisbett, Peng, Choi, & Norenzayan, 2001). Initially, this literature focused on self-report and performance-based measures to show systematic cultural variations between Eastern (mostly East Asian) cultures and Western (mostly European American) cultures. In more recent years, there has been concerted effort to extend this literature with neural measures to test the degree to which the cultural differences would be reflected in neural processes. Thus, having been equipped with neuroscience techniques such as functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG), researchers have tested how "deep under the skin" culture might go in the domains of cognition, emotion, and motivation. This effort has yielded cumulative evidence on plastic neural changes resulting from cultural experience (Han et al., 2013;

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Kitayama, Park, & Cho, 2014; Kitayama & Uskul, 2011; Kitayama et al., in press). While much of the currently available evidence relies on functional properties of the brain, some initial effort is underway to determine cultural influences on its structural features (Chee, Mheng, Goh, Park & Sutton, 2003; Kitayama, Yanagisawa, Ito, Uchida, & Abe, 2017; Wang, Peng, Chechlacz, Humphreys, & Sui, 2017). The first goal of the present article is to summarize this development and discuss its contributions to the knowledge base of cultural influences in psychology.

In addition to reviewing the current cultural neuroscience evidence, another significant goal is to address one shortcoming of the current cultural psychological work. The cultural psychological research has so far been limited largely to comparisons between East Asians and European Americans. While it is increasingly clear that "non-Western" interdependent culture is by no means monolithic (Cohen, 2009; Kitayama, Duffy, Kawamura, & Larsen, 2003; Kitayama, Ishii, Imada, Takemura, & Ramaswamy, 2006; Talhelm et al., 2014; Vignoles et al., 2016), this diversity has yet to be fully understood. To address this limitation, in our review we integrate pertinent research with a focus on another major ethnic group, namely, Latinos.

The focus on Latinos in the United States is important. First, whereas the Latino population is the most rapidly growing today in the United States, it is noticeably falling behind in both health and education, calling for systematic research on sources of psychological resilience. Second, in the United States, Latinos of several generation levels are likely undergoing a major cultural shift due to both societal demands for assimilation and personal desires for maintaining a unique ethnic identity. Accordingly, the Latino group is likely to provide a timely opportunity for all scholars who wish to observe the process of dynamic cultural change and adaptation in vivo. Third, with a focus on Latinos, we will empirically identify a major variant of interdependence. As we shall see, this form of interdependence is likely to be distinct from the one commonly discussed in the literature, namely, Asian interdependence (Markus & Kitayama, 1991).

Fortunately, evidence among Latinos is emerging. While this evidence is in most cases still scant and preliminary, we review what little evidence is available in what follows to put forward initial hypotheses about another form of interdependence for Latinos that is distinct from the one for Asians. Our review is organized around three themes of dispositional inference, emotion regulation, and self-centric motivation. These themes are chosen to maximize the diversity of topics covered while ensuring that some initial evidence is available for both Asians and Latinos.

From Cultural Psychology to Cultural Neuroscience

Self-construal: Independence and interdependence

Existing evidence on cultural variations in psychological processes between East Asians/Asian Americans and European Americans is largely grounded on the hypothesis that macroscopic cultural traditions are based on distinct construals of the self in relation to others (Heine, 2015; Kitayama & Park, 2010; Kitayama & Uskul, 2011; Markus & Kitayama, 1991; Triandis, 1995). In European American cultures, there is a strong belief of the self as autonomous, independent, and separate from the social context. That is, European Americans are thought to hold an *independent construal of the self*. Moreover, independent self-construal is associated with a cognitive focus on objects that are relevant to one's goals, fostering a mode of thought that is focused, linear, and logical, called the analytic mode of thought (Nisbett et al., 2001). In contrast, in many other cultures, including Asian cultures, there is a greater emphasis on social relations as an important element of the self. In Asian cultures, in particular, the self is defined by roles, duties, and obligations in close relationships such as family, work, and other primary social groups. That is, Asians are thought to hold an *interdependent construal of the self*. Moreover, interdependent self-construal encourages attention to a whole field in which various objects are embedded, resulting in a mode of thought that is diffused, dialectical, and intuitive, called the holistic mode of thought (Nisbett et al., 2001).

One common method to assess self-construal is to ask participants to rate themselves on questionnaire items, such as "Being able to take care of self is a primary concern for me" for independence and "I have respect for the authority figures with whom I interact" for interdependence (Singelis, 1994). A meta-analysis shows that compared to European Americans, Asian and Asian American samples were less independent (or less individualistic) and, to a lesser extent, more interdependent (or collectivistic) (Oyserman, Coon, & Kemmelmeier, 2002). Those from Latin countries such as Brazil, Mexico, and Peru were slightly less independent and more interdependent than European Americans.

It is important to note that there are inconsistencies at the individual study level, calling for some caution to be taken in the use of the self-report indicators. In particular, when explicitly asked to evaluate themselves on given dimensions (e.g., height or weight as well as independence or interdependence), people may compare themselves with others in their cultural or ethnic group. This "reference group effect" may dilute the real cultural

difference that exists (Heine, Lehman, Peng, & Greenholtz, 2002). Equally important, culture is often tacit, and thus people may fail to recognize their culture (Kitayama, 2002). Furthermore, *what* people report about themselves may or may not correspond to their habitual modes of operation—*how* they think, feel, and act.

For these reasons, researchers have supplemented explicit scales with implicit measures of culture that reveal the extent of independence or interdependence without explicitly asking the participants (Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009). These implicit measures are sometimes called "behavioral" in the sense that they are based on observable responses such as reaction time, memory, and other aspects of performance to index independence and interdependence. More recent work has utilized neural measures (e.g., fMRI and EEG) to extend this work (Han et al., 2013; Kitayama & Park, 2010; Kitayama & Uskul, 2011; Kitayama et al., in press). Growing evidence reveals sizable cultural differences supporting the hypothesis that Asians are more interdependent and less independent than European Americans even at the neural level.

We expect unacculturated Latinos will be similar to Asians in that both groups tend to be more interdependent and holistic than European Americans. This is supported by a well-documented emphasis on relational ties in Latin cultures (Sanchez-Burks, Nisbett, & Ybarra, 2000). Scholars have suggested that the key component of interdependence among Latinos is *familial obligation* (Telzer & Fuligni, 2009; Telzer, Ichien, & Qu, 2015), whereas Triandis argues that *simpatía*, or emotional interdependence with close others, is the distinguishing component to Latino interdependence (Triandis, Marín, Lisansky, & Betancourt, 1984). In support of these suggestions, Sanchez-Burks and colleagues tested workplace attitudes and preferences, showing that whereas European Americans are focused exclusively on work, Mexicans focus more on social relationships in the workplace (Sanchez-Burks et al., 2000).

However, Latinos are likely different from Asians in some respects. In the aforementioned work, Sanchez-Burks et al. (2000) argue that like Asian cultures, Latin cultures emphasize interdependence, and yet, unlike Asians, Latinos place an especially strong "emphasis on expressive displays of personal charm, graciousness, and hospitability" (p. 175). In particular, as we shall see, while Asians regard high-arousal-positive emotions such as excitement and joy as a hindrance to social harmony, Latinos may use them as a means to forge social connections. The emphasis on emotion expressivity may be due in part to historically high levels of ethnic diversity in many Latin cultures (Rychlowska et al., 2015). It may also be linked to the general looseness in norm enforcement (Gelfand et al., 2011).

Regarding Latino Americans, it is reasonable to anticipate that as a function of acculturation into the mainstream (i.e., European American) U.S. culture, they will show more independent and less interdependent tendencies. At the same time, insofar as the mainstream U.S. culture is likely to place a greater normative emphasis on emotional restraint (Sanchez-Burks, 2002), acculturating Latinos may become emotionally less expressive.

Why neural measures are critical

As we shall see, cultural differences in many psychological domains have been amply demonstrated with rating scales and implicit (i.e., performance-based) indices. It is therefore legitimate to ask why we might need neural measures at the outset.

One important reason is empirical. It may seem obvious that all psychological effects are mediated by certain brain mechanisms. Hence, it may not come as any surprise that for any given psychological effect that is demonstrated, one can show that there is an equivalent effect at the neural level. Nevertheless, we need a series of focused neuroscience investigations to reveal exactly how the effect is implemented in the brain (Han, 2015). The knowledge of neural mechanisms will clarify stages of neural processing that likely underlie any given behavioral effect, and thus offer important theoretical insights on the original psychological effect. For example, if a tendency to automatically draw dispositions from a single behavior (called the fundamental attribution error; see the later discussion) is universal, we would expect similar results across cultures in early stages of processing. This question may be best addressed with certain neural measures that enable one to identify the specific stage at which the cultural difference occurs. To put it another way, whereas a careful examination of a cultural difference in performance measures such as memory, reaction time, judgment, and the like can reveal the presence or absence of the difference, it often falls short of specifying how this cultural influence may be implemented in specific brain mechanisms. To address this latter question, neural measures will be indispensable.

Another reason is methodological. Researchers have long recognized that self-report measures are relatively easy to manipulate and change intentionally. This makes them subject to various artifacts due to social desirability, scale use, demand characteristics, and social comparison (e.g., the reference group effect). These problems are likely less relevant although may persist if researchers use implicit (i.e., performance-based) measures where overt responses such as reaction time, memory, and the like are used to make inferences about independence or interdependence. These biases could obscure the real

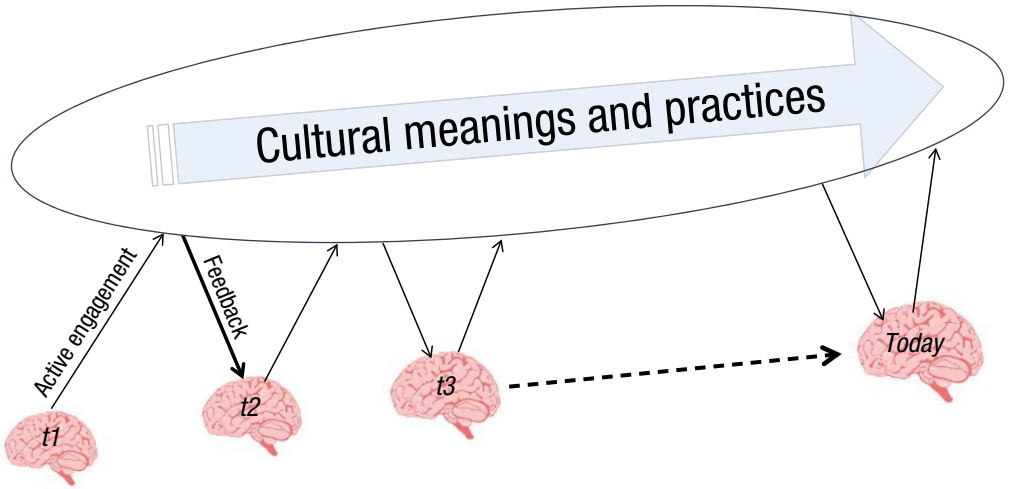

Fig. 1. A theoretical model for the plastic change of the brain through active engagement with culture: Biological systems of the mind (represented in an image of the brain) are engaged with an external environment defined by cultural meanings and practices from the moment of conception. They will then receive feedback, which reinforces changes that are brought about to realize the engagement. Through continuous cycles of engagement and feedback, the biological systems are gradually shaped, modified, and transformed to be attuned to and thus to be part of the culturally defined environment.

cultural or individual differences. Since neural responses cannot be controlled as easily, especially in early stages of processing, they may yield more valid measures of cultural influences that are uncontaminated by any response biases. In addition, it bears an emphasis that neuroscience measures yield a rich array of data, while avoiding the danger of having the measures affect one another because of semantic overlap in the constructs being assessed, as may often occur in self-report measures (Kitayama & Park, 2017).

Perhaps more important, the value of new methods may lie in the very fact that they are new. It may enable us to see the phenomenon at issue in different ways, paving the way toward new conceptualizations of it (Greenwald, 2012). In the case of culture, we may expect that the neuroscience methods may challenge the old dichotomy that juxtaposes culture in opposition to biology and raise new questions on how the two seemingly opposing processes may mutually constitute one another.

Above and beyond the empirical or methodological reasons discussed so far, there is a more fundamental, theoretical reason as well. Kitayama and Uskul (2011) suggest that through socialization, neural networks are plastically formed and modified through various rewards and reinforcements over time and become patterned after cultural beliefs, values, and practices. As shown in Figure 1, from the very beginning of its existence, a human brain actively engages in its environment. This engagement is likely to start at the very moment of conception. Evidence shows that the fetal environment exerts influences on the biological systems of unborn infants (Phillips, 2007; Wadhwa, 2005). After the birth, however, this engagement becomes more active. For example, if the infant smiles at her mother, she may immediately smile back with a warm touch. This positive feedback is likely to reinforce all neural connections that are instrumental in forming the initial smile behavior. This active engagement and feedback cycle will be repeated continuously for the duration of the entire life. The environment may be initially constituted by a small number of caregivers. However, over time, it will expand to include various settings and institutions organized by meanings and practices of the particular local cultural group.

It is important that, upon receiving feedback, neural networks will be changed. While each change may be small and barely observable, it is likely to accumulate in accordance with the principle of Hebbian learning (neurons firing together to be wiring together, see Gallistel & Matzel, 2013) if the feedback is consistent over time. Although the beliefs and practices of any given culture are extremely diverse, there are some common elements that cut across this variability. These reflect central values and priorities of the culture such as independence and interdependence. As the common elements of culture are engaged through consistent feedback, they will contribute to a cumulative change of the neural networks. This amounts to the hypothesis that the neural networks that emerge through socialization encode and store cumulative cultural experience. Although the culturally shaped neural networks can influence self-report and performance-based measures, this influence is confounded by more immediate situational and personality factors. Moreover, the cumulative neural information will hardly be accessible to conscious awareness. It may therefore be anticipated that *cumulative* cultural effects

will be more reliably detected if the brain is probed directly with neural indices. Thus, theoretically relevant constructs often correlate with spontaneous neural process (Kitayama & Uskul, 2011), while infrequently with self-report and performance (or behavioral) measures (Kitayama et al., 2009; Na, Grossmann, Varnum, Kitayama, & Nisbett, 2010). Thus, the use of neural measures to study culture can provide additional information on timing and individual differences that cannot be obtained with self-report and performance-based measures alone.

Culture and the Brain

Dispositional attribution

Previous work in cultural psychology has demonstrated that cultures vary widely in the propensity to draw dispositional inferences in person perception (Choi, Nisbett, & Norenzayan, 1999; Nisbett et al., 2001). In Western cultures including both North America and Western Europe, people attribute the cause of a behavior to internal traits, attitudes, or personal dispositions even when the behavior is socially constrained. This effect is called correspondence bias (Jones, 1979) or the fundamental attribution error (Ross, 1977).

Early on, however, Miller questioned the universality of this effect (Miller, 1984). Replicating numerous Western studies, she found that residents in Chicago cited a person's personality traits and other dispositions when asked to explain why someone they knew performed certain behaviors. In contrast, Indians in India cited duties, obligations, and other contextual factors in accounting for the person's behavior. Morris and Peng subsequently asked American and Chinese participants to account for the ways in which fish behaved in various video vignettes. They found a strong dispositional bias among Americans, but no such bias among Chinese (Morris & Peng, 1994). This cultural difference has since been repeatedly observed (Choi et al., 1999; Kitayama et al., 2009; Masuda & Kitayama, 2004; Miyamoto & Kitayama, 2002). This cross-cultural pattern is consistent with the hypothesis that European Americans believe in an independent model of the self (which primes an expectation that another's behavior is motivated by this person's internal traits), whereas Asians believe in an interdependent model of the self (which primes an expectation that the person's behavior is strongly constrained or afforded by external factors that surround the person).

Gilbert and Malone (1995) proposed that dispositional attribution is quick and automatic, and serves as an anchor for subsequent inferences. Thus, only later are situational constraints considered and optionally taken into account. This model would account for the observed cultural differences by assuming that Asians are more likely to take situational considerations into account in later stages of person perception, consistent with prior evidence that situational constraints are more salient for Asians than European Americans (Choi et al., 1999). An earlier neuroimaging study does show that the two cognitive operations (dispositional judgment and situational constraint) are distinct in terms of the brain regions involved (Han, Mao, Qin, Friederici, & Ge, 2011). It is not clear, however, whether dispositional inference is also automatic for Asians. It is possible that in interdependent cultures in which behaviors are seen as strongly influenced by contextual factors, people may not acquire a strong tendency to draw the dispositional inference to begin with.

To test this possibility, Na and Kitayama (2011) analyzed the automaticity of spontaneous trait inference (Na & Kitayama, 2011). In their Study 2, for example, both European American and Asian American participants were asked to memorize many face-behavior pairs (e.g., she checks fire alarm before going to bed) that implied a certain trait (e.g., carefulness). At this stage, if spontaneous trait inference occurs, people will infer the trait (e.g., careful) corresponding to the behavior and bind it to the face. Thus, when the face is presented at a later point, the trait linked to the face should be immediately activated. To test this possibility, the participants were given a lexical decision task (see Fig. 2A for the trial structure) after the memorization phase. In the lexical judgment task, the participants decided whether a string of alphabetical letters was an English word or not. The word trials were divided into three different conditions. On some trials, one of the traits corresponding to the behaviors presented during the memorization phase was shown after the face (congruent condition), whereas on some other trials, an antonym of the trait was shown after the face (incongruent condition). The other set of trials included pseudo words. While the participants performed the lexical decision task, their EEG was monitored and recorded.

To analyze whether an implied trait had been attributed to the face, Na and Kitayama examined an event-related potential (ERP) component called N400, which is known to respond to various forms of semantic incongruity (Hehman, Volpert, & Simons, 2014; Kutas & Federmeier, 2011). If the face automatically activated a trait corresponding to the behaviors linked to the face, then the antonym of the trait (vs. implied trait) should evoke a significantly greater N400. As summarized in Figure 2B, European Americans showed a pronounced N400, which was significantly greater in the incongruent trait condition than in the congruent trait condition. In contrast, among Asian Americans, there was no N400 regardless of trait word congruency. This demonstrates that spontaneous trait inference is automatic for European Americans, but is absent for Asian Americans.

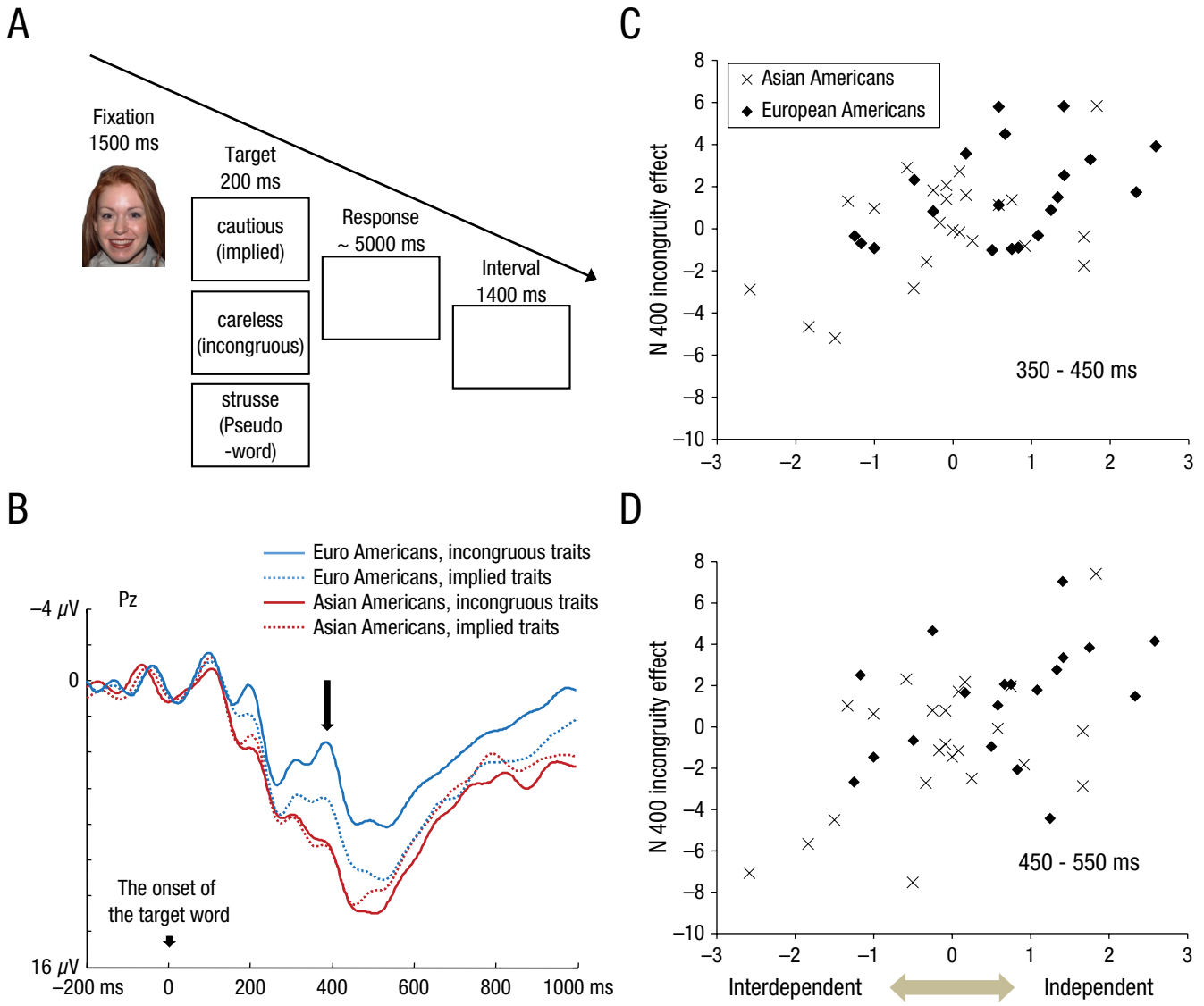

Fig. 2. Spontaneous trait inference European Americans and Asian Americans. (A) Lexical decision task used to detect the effect. (B) Increased N400 to the antonyms was evident only for European Americans. (C and D) In two time windows, the increased negativity in the antonym (vs. consistent trait) condition became more pronounced as a function of independent self-construal. Source: Adopted from Na and Kitayama (2011, *Psychological Science, 22*, 1025–1032).

It is important that across the two cultural groups the degree of spontaneous trait inference (i.e., the greater N400 in the incongruent vs. congruent trait condition) increased as a function of independent (vs. interdependent) self-construal (Figs. 2C and 2D). These correlations underscore our hypothesis that dispositional attribution is linked closely to an independent self-construal. This cultural difference has been replicated by Lee and colleagues, who used a different procedure (Lee, Shimizu, & Uleman, 2015).

Insofar as Latinos tend to be less independent and more interdependent, they may be expected to show less dispositional bias. In support of this prediction, Zárate and colleagues compared European Americans and Latinos. They showed that European Americans not only spontaneously activated the corresponding traits when reading behavioral descriptions, but also bound the traits to the faces of the persons showing the behaviors (Zárate, Uleman, & Voils, 2001). As may be expected, however, for Latino Americans these effects were substantially attenuated. In an unpublished study, Salvador and Lewis (2017) used the spontaneous trait inference paradigm by Na and Kitayama (2011) and tested Latino American college students. The researchers assessed acculturation by using a commonly used acculturation scale for Hispanics (Marín, Sabogal, Marin, Otero-Sabogal, & Perez-Stable, 1997). As predicted, there was no spontaneous trait inference among unacculturated

Latinos. However, as the level of acculturation and independence increased, the N400 spontaneous trait inference effect emerged. This is one of the first studies we know of that clearly show that brain responses change systematically as a function of acculturation into U.S. society (see also Hedden, Ketay, Aron, Rose Markus, & Gabrieli, 2008, for another such study).

Emotion regulation

The past decade of research on emotion regulation shows that European Americans have a high competence in down-regulating emotions when they are instructed to make certain changes at the initial stages of emotion processing by, for example, cognitively reappraising the focal event (Gross, 2002; Hajcak & Nieuwenhuis, 2006), self-distancing (Kross, Ayduk, & Mischel, 2005), engaging in self-talk (Kross et al., 2014), and distracting the self from the focal event (Thiruchselvam, Blechert, & Sheppes, 2011). For example, Goldin and colleagues (Goldin, McRae, Ramel, & Gross, 2008) showed that when asked to cognitively reappraise the content of an emotionally evocative film clip so that the meaning of the film content could become emotionally benign, European Americans successfully modulated their emotional reactivity as reflected in reduced activity in the amygdala, a brain region responsible for emotional processing. However, European Americans appear to be hard-pressed to down-regulate emotions that have already been evoked. In the same study by Goldin et al., when asked to suppress emotional expressions while exposed to the film, amygdala activity was not reduced. Instead, there was a significant *increase* of amygdala activity in the expressive suppression condition. The paradoxical potentiation of the amygdala under the condition of expressive suppression might suggest that European Americans ironically attended their emotions more, thereby increasing emotional processing in an effort to control them (Wagner & Heatherton, 2010). Mauss and Butler used cardiovascular measures of challenge and threat and showed that people immersed in Western ideas tend to regard emotion suppression as threatening rather than challenging (Mauss & Butler, 2010).

Without analyzing culture, one may assume that the difficulty in suppressing emotion is universal. However, an earlier study by Matsumoto and colleagues has shown that national means of the self-report level of emotion suppression tended to be predicted by national means of the values placed on hierarchy and collectivism (Matsumoto, Yoo, Nakagawa, & Multinational Study of Cultural Display Rules, 2008). These values are much stronger in Eastern societies including Asian societies than in Western societies. We may thus anticipate that whereas it is hard for European Americans to suppress negative emotional arousal, doing so should be relatively easy for Asians because high-arousal emotions are seen as a disruption to social harmony, and thus are undesirable (Tsai, 2007; Tsai, Knutson, & Fung, 2006). In testing this hypothesis, Murata and colleagues drew on neural measures so as to minimize any effects of demand characteristics. Specifically, we utilized an ERP related to emotion processing called the late positive potential or LPP (Murata, Moser, & Kitayama, 2013). The LPP is typically maximal at Pz (a midline-parietal electrode) and is characterized as a long-lasting positivity that peaks 400 to 700 ms after the onset of a stimulus and extends for the duration of the stimulus (Olofsson, Nordin, Sequeira, & Polich, 2008). Evidence shows that self-reported arousal ratings of stimuli are tightly related to the magnitude of the parietal LPP (Cuthbert, Schupp, & Bradley, 2000; Schupp et al., 2000). Moreover, combined ERP and fMRI studies established a link between LPP and the limbic emotional processing regions including the amygdala (Sabatinelli, Bradley, Fitzsimmons, & Lang, 2005; Sabatinelli, Lang, Keil, & Bradley, 2006).

In the Murata et al. (2013) study, both European American and Asian participants were exposed to a series of either extremely negative or neutral pictures. In one condition, participants were asked to merely observe the pictures, whereas in the other condition, they were instructed to minimize their emotional responses so that an observer in the other room (who was allegedly watching them through a webcam) could not tell what picture they were viewing. The researchers observed that (a) the initial peak of LPP elicited by emotional pictures around 400 to 600 ms after the onset of them was equal in magnitude between the two cultural groups regardless of the instruction condition. It is important, however, that (b) a cultural difference emerged in a subsequent phase of the LPP that signifies down-regulation of emotional processing. The reduced LPP in the suppression (vs. attention) condition was significantly more pronounced for Asians than for Caucasian Americans. The ability to detect such a nuanced cultural difference would have been difficult without neural measures. In a recent study, Varnum and Hampton (2017) replicated this finding and extended it to test cultural differences in the enhancement of positive emotions. They instructed participants to boost their emotional experience to positive images and found that European Americans up-regulated their LPP, while this effect was negligible for Asians.

How about Latinos? While both Asians and Latinos are equally interdependent, they are likely to vary in the meaning given to emotions. In Asian cultures, emotions are typically seen as a hindrance of social harmony and thus high-arousal emotions are not valued

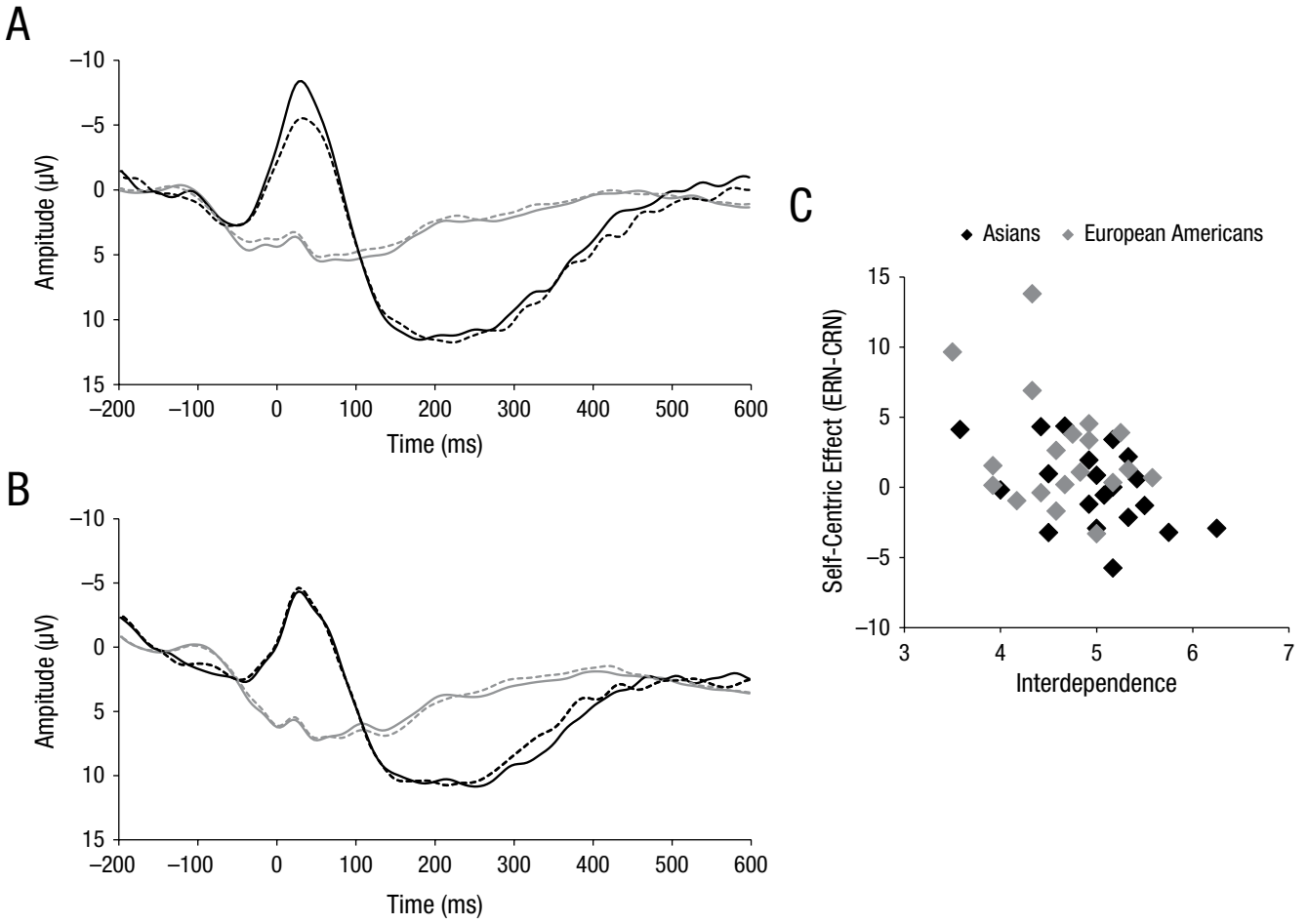

Fig. 3. Self-centric effect in ERN (error-related negativity) is clearly observed for Caucasians (A), but not for Asians (B). The effect is inversely predicted by interdependent self-construal (C). Source: Adapted from Kitayama and Park (2014, *Journal of Experimental Psychology: General, 143*, 62–70).

even when they are positive (Park, Tsai, Chim, Blevins, & Knutson, 2016). However, in Latin cultures, high-arousal positive emotions may serve as a way of forging social ties. Thus, high-arousal emotions, especially positive ones, may be desirable. Consistent with this, Soto and colleagues found that compared to Chinese Americans, Mexican Americans experienced significantly more positive and negative emotions (Soto, Levenson, & Ebling, 2005). Converging evidence shows that Latin Americans value happiness, with the reason being that this emotion is seen as reinforcing positive interdependence (Diener, Scollon, Oishi, Dzokoto, & Suh, 2009). Indeed, Mexican Americans value high-arousal positive emotions as strongly as European Americans do and, in this regard, they are very different from East Asians (Hong Kong Chinese), who value high-arousal positive emotions less (Ruby, Falk, Heine, Villa, & Silberstein, 2012). Su et al. (2015) found that Mexican Americans who suppressed their positive emotions reported lower wellbeing and life satisfaction compared to Chinese Americans. All in all, it stands to hypothesize that Latinos place a strong value on both expression and experience of high-arousal positive emotions as a means for achieving social interdependence.

One current shortcoming comes from the lack of any neuroscience data on Latinos on the topic of emotion. Nevertheless, some initial evidence based on self-report suggests that unacculturated Latinos may have an especially strong competence in up-regulating high-arousal positive emotions or, alternatively, they may have a difficulty in down-regulating such emotions. Future work must explore these possibilities. In testing them, it is important to supplement existing self-report measures with neuroscience measures and avoid any self-report biases or semantic artifacts. A few have used physiological measures such as skin conductance or heart rate, but these studies have yielded inconsistent results, thus calling for a more reliable index of emotion processing (Soto et al., 2005; Soto, Perez, Kim, Lee, & Minnick, 2011). The LPP, for

example, could be adopted as a reliable index of emotion processing.

Self-centric versus other-centric motivation

Humans are sometimes highly prosocial and exquisitely attuned to social information. For example, people spontaneously take perspectives of others, experiencing empathy and sympathy (Meyer et al., 2013; Singer, 2004; Singer, Critchley, & Preuschoff, 2009). Moreover, they deviate systematically from economic rationality by being prosocial even where there is no obvious payoff to the self (Yamagishi et al., 2016). Nevertheless, this by no means implies that humans are completely prosocial as they are also committed to the promotion of their self-interests. We may expect that there is a delicate balance between self-centric and prosocial (or other-centric) orientations, with the balance dynamically shifting as a function of independent versus interdependent self-construal. The prosocial or other-centric orientation will become more salient for interdependent (vs. independent) people since social relations are more central.

In our recent study, we have developed an ERP index of self-centric versus other-centric motivation (Kitayama & Park, 2014). Prior work established that whenever an error is made, the error is accompanied by an error-related negativity (ERN), a marked negative deflection of ERP that is coterminous with the error itself. The ERN is thought to reflect a mismatch between the representation of a correct response and that of a response that is erroneously executed (Gehring et al., 2012). When participants are more motivated, the magnitude of the component may increase since the representation of the correct response is more quickly and clearly developed. In effect, the magnitude of ERN may serve as a neural indicator of task motivation. In the study by Kitayama and Park (2014), both European Americans and Asians performed a simple speeded cognitive task to earn points. In some of the blocks of the study, they earned points to receive a better gift for themselves, whereas in the remaining blocks they earned points to receive a better gift for their best friend. As shown in Figures 3A and 3B, one striking cultural difference emerged: Whereas the ERN was reliably greater in the self-blocks than in the friend-blocks for European Americans, among Asians the ERN did not differ in the self-blocks compared to the friend-blocks. Moreover, as shown in Figure 3C, across the two cultural groups, the self-centric effect decreased systematically as a function of interdependent self-construal. It is important that Asian participants tended to be more interdependent European American participants, which accounted for the null self-centric effect among Asians (see Hitokoto, Glazer, & Kitayama 2016, for a conceptual replication with an alternative ERP measure and Kitayama et al., 2017 for an extension with a measure of cortical volume).

Latinos might show other-centric effects in similar conditions. Telzer and colleagues addressed this question by scanning both European Americans and Mexican Americans as they decided whether or not to accept a series of offers (Telzer, Masten, Berkman, Lieberman, & Fuligni, 2010, 2011). Some offers involved a reward to the self without any money taken away. For example, $4 was to be given to the self, whereas no amount was to be taken away from a family member (noncostly reward). More than 99% of these noncostly rewards were accepted. However, some other offers involved a costly donation. For instance, a family member would be given $4, while $2 was to be taken away from the self. The acceptance rate dropped to 66% on the costly donation trials, which did not depend on ethnicity. It is important that a reliable ethnic difference emerged when the activity of the reward processing regions (some different segments of the ventral striatum) was tested. "While (European Americans) showed more reward activity when gaining cash for themselves, Latino participants showed more reward activity when contributing to their family" (Telzer et al., 2010, p. 514).

The Telzer et al. study opens up several important questions. First, it is not clear why the acceptance rate for the costly donation to a family member is not higher for Latinos than for European Americans if this option is truly more rewarding for them. It may be the case that the overt responses are influenced by personal and situational factors that are unique to the specific setting at issue (e.g., local norms valuing the pursuit of self-interest in U.S. high schools), as opposed to long-term socialization, which may be captured more effectively with neural indicators (see Fig. 1). Second, this study shares with many other prior studies an assumption that the form of interdependence among Latinos is strongest vis-à-vis the family (Sabogal et al., 1987). However, this interdependence may be more encompassing and include other close social relations such as friends. Third, the other-centric motivation effect may also be influenced by the extent of acculturation; which future work should test. Last, it would be interesting to test both Latinos and Asians within the same paradigm. either the one by Telzer and colleagues or the one by Kitayama and Park.

Summary

The studies briefly reviewed support the idea that certain effects that are likely masked in overt responses or

self-reports may be uncovered with neural indicators (see Kitayama et al., in press for a more exhaustive review). For example, in the Kitayama and Park (2014) study, Americans were clearly self-centric with an EEG measure even though they were reluctant to admit it through self-report. A similar pattern is evident in Telzer et al. (2010, 2011), wherein the European versus Latin American cultural difference was evident in reward activity of the brain, but not in a conceptually related choice behavior. Moreover, when various cognitive and motivational processes are tested with behavioral measures, it is rare that these measures are predicted by theoretically relevant attitude variables, most notably, self-construal. For example, Kitayama et al. (2009) used multiple implicit measures of independence or interdependence, but none of them was correlated with independent versus interdependent self-construal. In contrast, when the comparable constructs are assessed with neural measures, it is typical that these measures are predicted by the self-construal measure in the theoretically predicted directions (Kitayama & Uskul, 2011). In fact, self-construal is systematically linked to neural measures of both dispositional inference (Figs. 2C and 2D) and self-centric motivation (Fig. 3C). Recent evidence utilizing regionally-specific cortical volume is consistent with this observation (Kitayama et al., 2017; Wang et al., 2017).

To advance the knowledge in this area further, it will be crucial to examine cultures other than European Americans and Asians. For example, as we noted above, Latinos may use emotional expressivity as a means for promoting interdependence, whereas Asians may utilize emotional suppression for the same goal. Here, then, even though both Latinos and Asians are equally interdependent (as compared to, say, European Americans) consequences of enhanced interdependence may vary. In this way, it may be possible to differentiate the very notions of independence and interdependence as uniquely configured as a function of specific local situational and cultural contexts.

Last, but not least, we wish to emphasize that neural measures by no means are intended to replace more traditional self-report or performance-based measures. To the contrary, the neural measures are used to supplement such more traditional measures. To our knowledge, few studies have systematically examined both performance-based measures of culture and their neural counterparts, but doing so may prove to be important to better understand the nature of culture. When the results converge, it will give us stronger confidence in the effects we observe. When the results diverge, they will give us a new window of further inquiry into how the brain, behavior, and self-reflection are dynamically linked to culture.

Back to the Future

After spending so many hours spilling ink on the topic of culture and psychology, we sometimes go to the past for ideas and insights. Often we find similar issues and questions along with admirable efforts to address them that foreshadow the current cutting-edge knowledge. The questions raised in the present article—enculturation, acculturation, the link of culture to biology, East-West differences of the self, among others—had in fact been raised and debated by our intellectual ancestors over the past 200 years (Jahoda, 1993).

Humbling as it is, the recognition that we have only circled back to the past should not discourage us. Our review has made it clear that through systematic applications of empirical tools such as surveys and experimentation of the 1990s, as well as neuroimaging of more recent years, our understanding of culture, psychology, and biology has both expanded and deepened. Moreover, although not covered in this article, cultural work employing methods of genetics (Kim & Sasaki, 2014), epigenetics (Kitayama, Akutsu, Uchida, & Cole, 2016), and neuroendocrinology (Kitayama & Park, 2017) is now on the horizon. As a result of this effort we now know that culture is embrained (and embodied) in the most literal sense and the field is beginning to raise fundamental questions about how. The cultural neuroscience approach has paved its way into specific biological mechanisms involved in cultural learning (Kitayama, King, Hsu, Liberzon, & Yoon, 2016). The adoption of the neuroscience approach can also clarify the nature of individual and group level differences in independent or interdependent orientations. Moreover, we can now readily point out certain macroscopic factors including ecology (Talhelm et al., 2014), economy (Henrich, McElreath, Barr, Ensminger, & Barrett, 2006), migration (Kitayama et al., 2006), and social structure (Kraus, Piff, & Keltner, 2011) that undergird each culture's symbolic landscapes. In combination, we have reason to be optimistic that the field is now well poised to go back to the future and seek a new theoretical integration of biology and culture, or that of nature and nurture, which is well grounded in empirical observations and scientific evidence.

Declaration of Conflicting Interests

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