



Review

Concerns about cultural neurosciences: A critical analysis

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ABSTRACT

Ten years ago, neuroscientists began to study cultural phenomena by using functional MRI. Since then the number of publications in this field, termed *cultural neuroscience* (CN), has tremendously increased. In these studies, particular concepts of culture are implied, but rarely explicitly discussed. We argue that it is necessary to make these concepts a topic of debate in order to unravel the foundations of CN. From 40 fMRI studies we extracted two strands of reasoning: models investigating universal mechanisms for the formation of cultural groups and habits and, models assessing differences in characteristics among cultural groups. Both strands simplify culture as an inflexible set of traits and specificities. We question this rigid understanding of culture and highlight its hidden evaluative nature.

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1. Introduction

“There are two distinct strands of thought within the twentieth-century history of biological determinism. The first [...] is the argument that assumes socially relevant *differences* between individuals and groups [...]. The second claims to account for, not differences but assumed *universals* in human nature [...]” Steven Rose (2001b)

In the humanities, “culture”² has been a topic of discussion since the 18th century (Busche, 2000). By contrast, the natural sciences – specifically the cognitive neurosciences – have picked up on this topic only in the last decades (Chiao, 2009; Han and Northoff, 2008; Kitayama and Park, 2010; Losin et al., 2010; Vogeley and Roepstorff, 2009). In the year 2000, functional magnetic resonance imaging (fMRI) studies were published for the first time in order to investigate this issue (Hart et al., 2000; Phelps et al., 2000). Today, this field of research is called *cultural neuroscience* (CN), and the number of publications and research grants related to it has increased tremendously. One definition sees CN as “a theoretical and empirical approach to investigate and characterize the mechanisms by which [the] hypothesized bidirectional, mutual constitution of culture, brain, and genes occurs” (Chiao and Ambady, 2007). According to this definition CN, takes the diversity of “cultures” as a starting point. In contrast, other examples from the field of CN investigate the universal mechanisms of the interaction between “cultural groups”, e.g. Adams et al., 2010; Chiao et al., 2008; Derntl et al., 2009a; Rule et al., 2009. Both approaches are based on comparisons between divided groups and communities, e.g. Easterners vs. Westerners, Asian vs. Caucasian, Americans vs. Turks, Blacks vs. Whites. Few researchers have highlighted critical aspects of CN. Among them, however, Choudhury and Kirmayer point to parallels to patterns in colonial psychiatry, criticize the “*biologizing of social facts*”, and elaborate the social consequences of this “biologized” difference in terms of “*discrimination and disadvantage*” (Choudhury and Kirmayer, 2009). Additionally, Vogeley and Roepstorff (2009) discuss not primarily content-related, but rather – as well as Losin et al. (2010) – methodological flaws of CN. Instead of adding further remarks in the present summary of CN articles, we aim at providing a foundation for a general critical review. Thereby, our main focus is not on methodological issues but on revealing implicit concepts of culture, ethnicity, or race. Our analysis intends to provide the theorization of such empirical research and to unravel heretofore unexamined assumptions. We develop a categorial system for expounding on the problems of reasoning in the field of CN. Two main lines of such reasoning are differentiated: firstly, investigation and elaboration of universal mechanisms for the formation of “cultural groups and habits” (called universalism), and secondly, the differentiation of characteristics among “cultural groups” (called differentialism). Furthermore, the type of comparison (within-participants vs. between-participants comparisons), the implicit valuation of these comparisons, the subject of the comparisons, and the applied concepts of culture were extracted and are discussed in the following section.

2. Anthropological approaches

“Culture”, although intensively investigated, remains one of the most difficult concepts to define in current times. There are two main subdisciplines in the history of anthropological approaches to explain the nature of culture: biological/evolutionary and

social/cultural anthropology. Biological anthropology investigates the link between culture and biology and between culture and race in part. It regards culture as part of the evolutionary process of humankind and focuses on (1) the question of whether or not “culture” is unique for human beings and on (2) the evolution of the human species, which is tightly linked to the former. In contrast to biological anthropology (and the evolution of culture), the definitions of culture which have been introduced by social/cultural anthropologists are based on Edward B. Tylor’s influential formulation: “*Culture or Civilization, taken in its wide ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society*” (Tylor, 1873). This pluralistic concept of culture clearly withdraws from categories such as race. However, these approaches introduce the category of ethnic groups into this field of research. Thus, differences in behaviors between social groups are explained without reference to (pseudo)biological causes but instead to social ones. Culture is defined as a “*more or less consistent pattern of thought and action*” (Benedict, 1934). Moreover, culture is a hot topic in contemporary debates in anthropology. Adam Kuper, for example, makes the field of anthropology itself a topic of debate. In his book, *Culture. The Anthropologists’ Account*, he evaluates the usefulness of the term “culture” as an analytical concept and, referring to anthropology in the 1990s, states that “*the current politicized discourse on culture provokes uneasy reflections on the implications of anthropological theory*” (Kuper, 1999). Regarding contemporary American anthropology, he summarizes that common sense in this field tells us to reject ideas that dictate that “*differences are natural, and that cultural identity must be grounded in a primordial, biological identity*”; at the same time, however, arguing with “*a rhetoric that places great emphasis on difference and identity*”. Together with Walter Benn Michaels he expounds on the problems of modern cultural concepts, which are not a “*critique of racism*” but “*a form of racism*” because cultural identity “*recourse[s] to the racial identity*” (Michaels, 1995). Kuper, however, criticizes the “*alternative to this slide into essentialism [...] to make identity into a cultural construct*” as well. Because “*this is to make culture (or discourse) into the only power in the land, and one that is apparently without any independent justification*” (Kuper, 1999).

Another contemporary approach in anthropology is brought forth by Lock and Nguyen, who aim at linking anthropology to biomedicine (Lock and Nguyen, 2010). By doing so, they question the standardized view on medicine and reconsider *differences* by introducing the term of “*local biologies*”. According to this view, human biology is subject to “*evolutionary, historical, and contemporary social change*”. The distinction between cultural and biological approaches is thereby aimed to be overcome.

3. Concepts of culture

As mentioned in the introduction, the nature and idea of culture has been subject to debates in the humanities for the past three centuries (Busche, 2000), first with Immanuel Kant and Johann Gottfried Herder, and then later with Wilhelm von Humboldt, Adolf Bastian, Matthew Arnold and finally Franz Boas. Today, various research disciplines treat the topic of culture and refer to these discourses about culture. Since there is no general consensus about the definition of culture, the way culture is sometimes treated even contradicts within disciplines. In 1952, Kroeber and Kluckhohn identified more than 150 different concepts of culture, and it is obvious that that number has even increased since then. Furthermore, the ambiguous application of the term *culture* in everyday language is an indication of an increasing drain of meaning. For this reason and in order to approach *culture* from a scientific perspective, it is inevitably necessary to precisely define

² The terms “culture” or “race” are written using quotation marks to clarify that we adapted them from the quoted studies, but would not make ourselves the same usage of them.

the underlying concept. A comprehensive review of the history and typology of the different concepts of culture is given by Andreas Reckwitz (2000). Reckwitz distinguishes four axes: the normative, the totality-oriented, the differentiation-theoretical and the meaning- and knowledge-oriented concept of culture. The first two concepts refer to the developments of the English and German Romanticism in the eighteenth and nineteenth century. The normative concept values *culture* as an attainable High Culture, which manifests in aesthetic categories that are inherited via art, morality, science, religion or law. In this concept, culture is considered as such in singular. Totality-oriented concepts refrain from aesthetic valuations and propose an equality of cultures. The totality-oriented concept regards collectives as thought, practice, and perception units. Such cultures are confined to themselves as discrete entities and can be compared accordingly to other cultures. This and the following two models conceptualize an impression of culture in plural. The differentiation-theoretical concept identifies cultures as subsystems within one system and is used in several systems theories. In addition to other social subsystems, such as health systems or political systems, culture refers here to a specific sector of society. In the last decades, the meaning- and knowledge-oriented concept of culture was the term most applied in humanities. It refers to a humankind-generated complex of thoughts, perceptions, values and meanings, which are materialized in symbolic systems. Common to all approaches that apply this latter concept is that culture is not confined to particular sub-domains but instead incorporates multiple and diffuse networks or rhizomes (Deleuze and Guattari, 1977), respectively.

Three well-known protagonists in humanities elaborate on such a definition of culture. First, Reckwitz conceptualizes culture not as a common way of living, ideas or texts but according to a “*theory of practice*” as knowledge-oriented social practices (Reckwitz, 2005). Second, Adam Kuper recommends avoiding “*the hyper-referential word [culture] altogether, and to talk more precisely of knowledge, or belief, or art, or technology, or traditions, or even of ideology (though similar problems are raised by the multivalent concept)*” (Kuper, 1999). Finally, Michael Fischer proposes the concept of culture as an “*experimental tool*” which makes “*visible the differences of interest, access, power, needs, desires, and philosophical perspective(s)*” (Fischer, 2007).

4. Guidelines for classification

For the classification of fMRI approaches to “culture” we extracted the concepts and assumptions used in the explanations of the studies. These were filed into two main categories that were regarded as most proximate to the studies’ argumentation patterns and will therefore allow critical evaluation of the processes in CN.

These categories correspond to the two main anthropological approaches to culture identified above: first, approaches based on a common human biology, and, secondly, approaches focussing on the plurality of cultural practices. To refer to these categories we freely adapted the classification introduced by Steven Rose in his book *Alas, Poor Darwin* to describe the two strands which life sciences apply to approach humankind (Rose, 2001b): universalism and differentialism. With these concepts, Rose tries to describe two different ways of determining human practices and behavior. However, we believe that there is a direct link from such a binarity to the description of “cultural phenomena” in CN. For the present qualitative analysis, we adapt these two strands of reasoning to the field of CN elaborating several subcategories to describe the various explanations offered for “cultural phenomena” (see Table 1; Supplementary Material I for in-depth clarification of the classification).

Table 1
Classification of fMRI approaches to “culture”.

Universalism and culture <ul style="list-style-type: none"> • assumptions about universal mechanisms of ingroup-outgroup formation, customs, or habits • “culture” as a methodological means for the demarcation of group-identity • mechanisms are investigated based on the interaction between “cultural groups” <ul style="list-style-type: none"> (i) Resemblance <ul style="list-style-type: none"> ○ phenotypical similarities between participants and/or stimuli ○ group membership is defined on the basis of putatively biological and directly observable characteristics, such as skin color (ii) Stereotype <ul style="list-style-type: none"> ○ differences in group-favoritism as a consequence of social learning ○ “race”/“culture” as a result of social construction processes (iii) Familiarity <ul style="list-style-type: none"> ○ differences in behavior toward other “races”/“cultures” due to lack of exposure to people, habits, or customs of another group
Differentialism and culture <ul style="list-style-type: none"> • “culture” is itself the subject of analysis • “cultural” knowledge or practices implicate variation of behavior and distinct neural activation patterns <ul style="list-style-type: none"> (i) Biological explanatory models <ul style="list-style-type: none"> ○ neurofunctional differences between “cultures” are explained by inherently manifested physiological characteristics (ii) Culturally acquired knowledge <ul style="list-style-type: none"> ○ “cultural” specificities are related to processes of socialization and learning <ul style="list-style-type: none"> • different understanding of subjectivity • different everyday regional/national practices and specificities • different language or script systems

5. Literature review

5.1. Selection of studies

We searched peer-reviewed journals [indexed in large databases (MEDLINE, Google Scholar, PsycInfo, PubMed; until 04-12-2010)] for English language manuscripts of original functional magnetic resonance imaging studies which addressed psychological processes with cultural content. These studies are summarized in Tables 2 and 3. Due to the novelty of the research field of CN, the literature research was not confined to a specific time period. All manuscripts included in the current analysis met the following inclusion criteria: (1) measurement of blood oxygenation level dependent (BOLD) effects using fMRI technology [search words: fMRI, functional MRI, magnetic resonance imaging, BOLD, brain-/neuroimaging; exclusion of studies investigating structural MRI, morphometry/VBM, EEG, or DTI/white matter]; (2) no restriction regarding the data analysis method or scanning parameters; (3) psychological processes, such as emotion, cognition, language, self, memory, motor aspects, etc., as the focus of the study; (4) human research subjects (rather than, e.g. primates); (5) culturally associated aspects addressed, either within the participants’ description or within the fMRI paradigm [search words: culture, ethnicity, demographic group, race, independence/interdependence, Eastern/Western, allocentric/egocentric, black/white]; (6) presented data fulfilled the criteria of original articles, conveying the discovery of new knowledge rather than emphasizing the development of methods or the review of an area of research. Our goal was to provide a full picture of the nascent field of CN and to qualitatively analyse its unexamined assumptions. Some of the included articles were identified after careful screening of citations in the initially collected articles. We subsumed studies under the umbrella term *cultural neuroscience* which did not label themselves as CN, but instead used terms such as race, ethnicity, population, demographic groups, nationality, etc. All of these terms have overlapping but at the same time distinct definitions. For example, Chiao defines culture according to Markus and Kitayama (1991) as “*a social group whose members share one or more of the following: a common*

Table 2
Universalism and culture.

Universalism and culture							
N	Author/year	Journal	WP	BP	Concept	fMRI task	Level of comparison
Resemblance							
<i>Phenotypic</i>							
A	Adams et al. (2010)	<i>J Cogn Neurosci</i>	×	×	TO	reading the mind in the eyes	White American–native Japanese
A	Chiao et al. (2008)	<i>J Cogn Neurosci</i>	×	×	TO	facial expression recognition	native Japanese–Caucasian in US
A	Derntl et al. (2009b)	<i>BMC Neurosci</i>	×		TO	emotion recognition in faces	African American–Caucasian Austrian
A	Derntl et al. (2009a)	<i>Soc Neurosci</i>		×	TO	emotion recognition in faces	Asian–Caucasian Austrian
A	Golby et al. (2001)	<i>Nat Neurosci</i>	×		Race	face perception	African American–European American
A	Hart et al. (2000)	<i>Neuroreport</i>	×	×	TO	face processing	White–Black
A	Krill and Platek (2009)	<i>Front Evol Neurosci</i>	×		Race	social exclusion	racial IG–OG, i.e. ingroup-outgroup
A	Lieberman et al. (2005)	<i>Nat Neurosci</i>	×	×	TO	race processing in faces	African American–Caucasian
A	Phelps et al. (2003)	<i>Neuropsychologia</i>	×		Race	face processing and IAT, i.e. implicit association test	White–Black
A	Richeson et al. (2003)	<i>Nat Neurosci</i>	×		Race	Stroop task	White–Black
A	Richeson et al. (2008)	<i>Group Process Intergroup Relat</i>	×		Race	face processing and eye-gaze direction	White–Black
A	Rilling et al. (2008)	<i>Neuroimage</i>		×	TO	prisoners dilemma	White–Black–Asian
A	Ronquillo et al. (2007)	<i>Soc Cogn Affect Neurosci</i>	×		Race	social categorization task, i.e. age evaluation	Afrocentric–Eurocentric
A	Rule et al. (2009)	<i>Soc Cogn Affect Neurosci</i>	×	×	TO	voting behavior	Japanese–American
A	Van Bavel et al. (2008)	<i>Psychol Sci</i>	×		Race	processing of IG and OG	IG–OG
A	Xu et al. (2009)	<i>J Neurosci</i>	×	×	TO	pain empathy while viewing faces	Caucasian–Chinese
<i>Constructed</i>							
A	Kobayashi et al. (2007)	<i>Brain Res</i>		×	MKO	false belief task	English monolinguals–Japanese/English bilinguals
B	Rilling et al. (2008)	<i>Neuroimage</i>		×	TO	prisoners dilemma	White–Black–Asian
B	Rule et al. (2009)	<i>Soc Cogn Affect Neurosci</i>	×	×	TO	voting behavior	Japanese–American
B	Van Bavel et al. (2008)	<i>Psychol Sci</i>	×		Race	processing of IG and OG	IG–OG
Stereotypes							
B	Chiao et al. (2008)	<i>J Cogn Neurosci</i>	×	×	TO	facial expression recognition	native Japanese–Caucasian in US
A	Cunningham et al. (2004)	<i>Psychol Sci</i>	×		Race	face processing [automatic/controlled]	White–Black
B	Derntl et al. (2009b)	<i>BMC Neuroscience</i>	×		TO	emotion recognition	African American–Caucasian Austrian
B	Hart et al. (2000)	<i>Neuroreport</i>	×	×	TO	face processing	White–Black
A	Knutson et al. (2007)	<i>Hum Brain Mapp</i>	×		Race	IAT with race and gender	Black–White names
B	Lieberman et al. (2005)	<i>Nat Neurosci</i>	×	×	TO	race processing in faces	African American–Caucasian
A	Phelps et al. (2000)	<i>J Cogn Neurosci</i>	×		TO	face processing	White–Black
B	Richeson et al. (2003)	<i>Nat Neurosci</i>	×		Race	Stroop task	White–Black
C	Rilling et al. (2008)	<i>Neuroimage</i>		×	TO	prisoners dilemma	White–Black–Asian
B	Ronquillo et al. (2007)	<i>Soc Cogn Affect Neurosci</i>	×		Race	social categorization task, i.e. age evaluation	Afrocentric–Eurocentric
C	Van Bavel et al. (2008)	<i>Psychol Sci</i>	×		Race	processing of IG and OG	IG–OG
A	Wheeler and Fiske (2005)	<i>Psychol Sci</i>	×		Race	categorization of faces vs. individuation	White–Black; European American–Asian American
Familiarity							
B	Adams et al. (2010)	<i>J Cogn Neurosci</i>	×	×	TO	reading the mind in the eyes	White American–native Japanese
C	Chiao et al. (2008)	<i>J Cogn Neurosci</i>	×	×	TO	facial expression recognition	native Japanese–Caucasian in US
B	Cunningham et al. (2004)	<i>Psychol Sci</i>	×		Race	face processing [automatic/controlled]	White–Black
A	Demorest et al. (2010)	<i>Soc Cogn Affect Neurosci</i>	×	×	TO/MKO	music memory	Turks–Westerners–Chinese, WP
C	Derntl et al. (2009b)	<i>BMC Neuroscience</i>	×		TO	emotion recognition in faces	Turks–USA, BP African American–Caucasian Austrian
B	Derntl et al. (2009a)	<i>Soc Neurosci</i>		×	TO	emotion recognition in faces	Asian–Caucasian Austrian
A	Goh et al. (2007)	<i>Cogn Affect Behav Neurosci</i>		×	TO	object/background processing	Asian–Westerners
B	Golby et al. (2001)	<i>Nat Neurosci</i>	×		TO	face perception	African American–European American
C	Hart et al. (2000)	<i>Neuroreport</i>	×	×	TO	face processing	White–Black
B	Knutson et al. (2007)	<i>Hum Brain Mapp</i>	×		Race	IAT with race and gender	White–Black names
A	Morrison et al. (2003)	<i>Neuroimage</i>	×	×	TO/MKO	music comprehension	trained–untrained; Chinese–Westerners
A	Nan et al. (2008)	<i>Hum Brain Mapp</i>	×		TO	music processing	Asian music–European music
B	Phelps et al. (2000)	<i>J Cogn Neurosci</i>	×		TO	face processing	White–Black
B	Phelps et al. (2003)	<i>Neuropsychologia</i>	×		Race	face processing and IAT	White–Black
B	Richeson et al. (2008)	<i>Group Process Intergroup Relat</i>	×		Race	face processing and eye-gaze direction	White–Black
C	Rule et al. (2009)	<i>Soc Cogn Affect Neurosci</i>	×	×	TO	voting behavior	Japanese–American

Note: N defines the number of appearances of the same publication; WP/BP denote the within-participants/between-participants comparisons; totality-oriented concepts of culture are abbreviated with TO; meaning- and knowledge oriented concepts of culture are abbreviated as MKO; Race signifies studies which do not explicitly use a concept of culture itself, but instead of race or racial groups.

Table 3
Differentialism and culture.

Differentialism and culture							
N	Author/year	Journal	WP	BP	Concept	fMRI task	Level of comparison
Biological explanatory models							
D	Chiao et al. (2008)	<i>J Cogn Neurosci</i>	×	×	TO	facial expression recognition	native Japanese–Caucasian in US
A	Gutchess et al. (2006)	<i>Cogn Affect Behav Neurosci</i>		×	TO	object processing, i.e. holistic vs. specific	Westerners–East Asians; Americans–Asians
A	Kobayashi et al. (2006)	<i>Brain Lang</i>	×	×	TO	language effects on ToM	bilinguals–monolinguals
A	Moriguchi et al. (2005)	<i>Neuroreport</i>	×	×	TO	facial expression recognition	Caucasian–Japanese
A	Okuyemi et al. (2006)	<i>Addict Biol</i>	×	×	TO/MKO	response to smoking cues/reward anticipation	African American–Caucasian–native Americans–low status Americans
C	Ronquillo et al. (2007)	<i>Soc Cogn Affect Neurosci</i>	×		Race	social categorization task, i.e. age evaluation	Afrocentric–Eurocentric
A	Zhang et al. (2006)	<i>Sci China C Life Sci</i>			TO	Chinese self	Chinese–Westerners
A	Zhu et al. (2007)	<i>Neuroimage</i>		×	TO	self-representation	independent–interdependent; Westerners–Easterners
Culturally acquired knowledge							
<i>Self concepts</i>							
A	Chiao et al. (2009b)	<i>Hum Brain Mapp</i>		×	TO	self-judgement task	Japanese–American
A	Chiao et al. (2009a)	<i>J Cogn Neurosci</i>		×	TO	cultural priming	Asian–Westerners
A	Han et al. (2008)	<i>Soc Neurosci</i>		×	MKO	trait judgement task	Christians–non religious
B	Kobayashi et al. (2007)	<i>Brain Res</i>		×	MKO	false belief task	English monolinguals–Japanese/English bilinguals
A	Kobayashi et al. (2008)	<i>Soc Cogn Affect Neurosci</i>			MKO	false belief task	early–late Japanese/English bilinguals
B	Moriguchi et al. (2005)	<i>Neuroreport</i>	×	×	TO	facial expression recognition	Caucasian–Japanese
D	Rule et al. (2009)	<i>Soc Cogn Affect Neurosci</i>	×	×	TO	voting behavior	Japanese–American
A	Sui and Han (2007)	<i>Psychol Sci</i>		×	MKO	priming of independence/interdependence	constructed groups of independence/interdependence
D	Van Bavel et al. (2008)	<i>Psychol Sci</i>	×		Race	processing of IG and OG	IG–OG
B	Zhang et al. (2006)	<i>Sci China C Life Sci</i>			TO	Chinese self	Chinese–Westerners
B	Zhu et al. (2007)	<i>Neuroimage</i>		×	TO	self-representation	independent–interdependent; Westerners–Easterners
<i>Regional/national practices and specificities</i>							
C	Derntl et al. (2009a)	<i>Soc Neurosci</i>		×	TO	emotion recognition in faces	Asian–Caucasian Austrian
B	Goh et al. (2007)	<i>Cogn Affect Behav Neurosci</i>		×	TO	object/background processing	Asian–Westerners
C	Golby et al. (2001)	<i>Nat Neurosci</i>	×		Race	face perception	African American–European American
A	Gron et al. (2003)	<i>Eur J Neurosci</i>		×	TO	nonverbal episodic memory, i.e. abstract objects	Chinese–Caucasian
B	Gutchess et al. (2006)	<i>Cogn Affect Behav Neurosci</i>		×	TO	object processing, i.e. holistic vs. specific	Westerners–East Asians; Americans–Asians
A	Hedden et al. (2008)	<i>Psychol Sci</i>		×	TO	perception/line length evaluation	East Asian–European American/independence–interdependence
C	Kobayashi et al. (2007)	<i>Brain Res</i>		×	MKO	false belief task	English monolinguals–Japanese/English bilinguals
C	Phelps et al. (2000)	<i>J Cogn Neurosci</i>	×		TO	face processing	White–Black
A	Tang et al. (2006)	<i>Proc Natl Acad Sci USA</i>		×	TO/MKO	arithmetic performance	English–Chinese; Eastern–Western
<i>Language system</i>							
B	Kobayashi et al. (2006)	<i>Brain Lang</i>	×	×	TO	language effects on ToM	bilinguals–monolinguals
D	Kobayashi et al. (2007)	<i>Brain Res</i>		×	MKO	false belief task	English monolinguals–Japanese/English bilinguals
A	Siok et al. (2004)	<i>Nature</i>		×	TO/MKO	reading/dyslexia	Caucasian–Chinese
B	Tang et al. (2006)	<i>Proc Natl Acad Sci USA</i>		×	TO/MKO	arithmetic performance	English–Chinese; Eastern–Western

Note: N defines the number of appearances of the same publication; WP/BP denote the within-participants/between-participants comparisons; totality-oriented concepts of culture are abbreviated with TO; meaning- and knowledge oriented concepts of culture are abbreviated as MKO; Race signifies studies which do not explicitly use a concept of culture itself, but instead of race or racial groups.

meaning system, social practices, geographical space, social and religious values, language, ways of relating, diet, and ecology” (Chiao et al., 2008). Contrary to culture, nationality is viewed as “a type of social group membership that can be acquired (e.g. citizenship by marriage) without necessarily sharing cultural experience, values, practices, or beliefs” (Chiao et al., 2008). Similar to nationality, race is regarded as “a type of social group membership that also does not necessarily involve shared cultural experience, values, practices, or beliefs”, but instead “[...] share a common ethnic heritage

and a subset of physical attributes (e.g. skin tone, facial, and body shape)” (Chiao et al., 2008). Okuyemi and colleagues suggest with Senior and Bhopal (1994) that “ethnicity is a more appropriate term to describe social groups, instead of race which historically has connoted a biological distinction” (Okuyemi et al., 2006). In spite of these definitions, we prefer to pool these terms for our analysis, as we believe that such categories are discursive constructions which are reproduced by a seemingly scientific distinction of the various terms. A similar set of problems applies to all of such terms

and, in agreement with Kuper, we are convinced that “*there are fundamental epistemological problems, and these cannot be solved by tiptoeing around the notion of culture, or by refining definitions*” (Kuper, 1999).

5.2. Organization of the results

Forty publications from August, 2000 to April, 2010 met our inclusion criteria. In a first step, we extracted the type of comparison (e.g. ingroup vs. outgroup, white vs. black), the applied concepts of culture (according to Reckwitz), and the psychological domain from each of the included manuscripts (see Tables 2 and 3). In a second step, we evaluated each manuscript according to our theoretical model of universalism and differentialism (see Table 1). We extracted passages which emphasized and validated the allocation to one of the above-mentioned theoretical categories (see Supplementary Materials 2 and 3). The categorization of studies was based on single quotations which is why some manuscripts are listed several times in the tables (see notes in Tables 2 and 3). Finally, we discussed each theoretical category with regards to the current literature on CN and provide examples of studies that met our theoretical criteria.

5.3. Types of comparisons in CN

“Cultural” comparisons include comparisons either between-participants, within-participants, or even both between- and within-participants. In the first case, the sample is not divided into several sub-groups of “cultures”, but the task addresses different “cultures” within the stimulus material, such as “*to investigate the influence of poser ethnicity, half of the stimuli were Caucasian (CA) faces; the other half African American (AA), and stimuli were equally distributed across facial expressions [...]*” (Derntl et al., 2009b). In a between-participants comparison, the stimulus material is held constant, but the sample consists of two or more “cultures”, e.g. “*eleven Americans (5 of them male) and 11 East Asians (6 of them male) participated in the study*” (Gutchess et al., 2006). Finally, comparisons within- and between-participants consist of two or more “cultural samples” and different “cultural stimulus” material, e.g. “*ten AA [African Americans] and ten EA [European Americans] right-handed males were recruited from San Francisco Bay Area colleges and universities. [...] Stimuli consisted of color photographs of 42 AA and 42 EA males standardized for neutral facial expression and background illumination*” (Golby et al., 2001) (see also Tables 1 and 2).

6. Theoretical classification of CN studies and discussion

In the following section we will review and discuss universality- and differentiality-based approaches separately. Overall, we assumed that each category with its respective subcategories contains problematic issues which were borne out by several of the mentioned studies, and will focus our discussion on those studies.

6.1. Universalism and culture

About half of the identified manuscripts either designed their fMRI paradigms according to universality-based approaches to “cultural phenomena” or at least provided explanations supporting this view. For example, Hart and colleagues state that their study “*was explicitly designed to assess fMRI responses to outgroup vs ingroup faces across subjects of both races, rather than to assess any differences that might exist between subjects based upon race*” (Hart et al., 2000). By this expression they clarify that their investigation and thus the origin of their study design focused on similarities, implying that the phenomenon in question, i.e. outgroup vs ingroup face processing, has a common, universal human

basis. This explanatory model is mostly based on assumptions of evolutionary psychology in explicit opposition to the ideology of social Darwinism, which assumes biological differences between distinguishable groups. The universal concept of culture explains differences between groups, not on a biological basis, but as a result of universal foundations (Rose, 2001a). However, “racial” or “cultural” group demarcation is postulated as a universal and biologically determined human principle. It serves as predisposition for racism or discriminative behavior, which is thereby interpreted to be common among all human beings. In agreement with this, evolutionary psychology, views racism in relation to natural selection affordances (Workman and Reader, 2004). On this foundation, such explanatory models have been intensively criticized (Rose and Rose, 2001) for biologizing racism, treating it as an unchangeable part of human nature, and thus providing a legitimization for it (Balibar and Wallerstein, 1990). In this way, structural imbalances of power are neglected. The same critique can be raised with respect to CN, where these evolutionary patterns of explanation have been picked up to illustrate processes of ingroup favoritism and own-race bias. Thus, different pre-given groups are used in the stimulus material or for the participants’ selection (see above). The assumption for the formation of such groups – not in the behavior or functional activation measures, but in phenotypical features – is that “races” (Golby et al., 2001; Richeson et al., 2003; Richeson et al., 2008; Ronquillo et al., 2007) and “cultures” (Adams et al., 2010; Chiao et al., 2008; Derntl et al., 2009a; Rule et al., 2009) are unambiguously distinguishable. We argue that by doing so the universal claim, which the mentioned studies take as their conceptual starting point, is waived. These issues are prominent in all three of the following subcategories; the additional argumentative peculiarities of each are discussed below.

6.1.1. Resemblance

Among these studies, universal explanations were most prevalently based on phenotypic similarities between participants and respective stimulus material [e.g. comparisons between black vs. white skin colors (Richeson et al., 2008), afrocentric vs. eurocentric features (Ronquillo et al., 2007) or between Japanese vs. Caucasian faces (Chiao et al., 2008)] and thus related to putatively biological criteria. The problem with this approach is that the outer appearance and, accordingly, the phenotypical definability of group membership form the main argument of group demarcation, ignoring underlying political and social processes. The biological existence of “races” is thereby assumed.

Moreover, some investigations base their argumentation on the assumption of an essential and insurmountable identification with people of the same outer appearance [e.g. assuming more pain-empathy (Xu et al., 2009) or attention to faces (Golby et al., 2001) for members of the same “race”]. As Phelps and co-workers have reported, “[...] *the amygdala response to social group information derived from faces appears to be automatic*” (Phelps et al., 2003), so that phenotypical features appear to be related to automatic processes of group-formation. Thereafter, the identification with one’s group seems to be an uncontrollable characteristic of human nature. Referring to the general critique on universalism, it is questioned if such a deterministic biological foundation for group-demarcations is still in opposition with social-darwinist assumptions about inherent biological differences between groups. We interpret this as evidence that there is only a short distance between them, since both have a deterministic view on group-identification. Again, a legitimization of racism is implied in studies of this category which view the mechanisms for group demarcation as being related to automatic ingroup favoritism: “*the better performance for in-group expressions of happiness and sadness, emotions that have a strong social aspect, could possibly be driven by stronger empathy for in-group faces. Higher accuracy for out-group expres-*

sions of disgust and anger, two negative and complex emotions in part indicating avoidance, might be especially important when expressed by out-group posers thus eliciting more attention" (Derntl et al., 2009b). Furthermore, in various research studies such reasoning is based on an evolutionary argumentation, e.g. that heightened bilateral amygdala response "may indicate heightened arousal to or vigilance for fear expressed by members of one's own cultural group because this expression serves as an indicator of impending threat (Glascher and Adolphs 2003; Davis and Walen 2001). More specifically, fear perceived in a member of one's own cultural group may be interpreted as more likely to indicate danger for one's self compared to fear perceived in a member from another cultural group (Elfenbein and Ambady 2002)" (Chiao et al., 2008).

A sub-group of research studies based their interpretations of a universality of "cultural phenomena" on constructed rather than phenotypic resemblances. For example, Rilling et al. (2008) make use of a minimal group paradigm with random distribution of participants either to a fictional red or a black group. Notably, this approach is not based on racial assumptions, but the same biological explanations for the demarcation of groups are offered. Without explicitly mentioning "races", the above-mentioned critique of legitimizing racism must likewise be applied as "it contributes to reifying socially constructed categories that may themselves be causes of discrimination and disadvantage" (Choudhury and Kirmayer, 2009).

The "Mexican" categorization (Kerner, 2009)

Until 1930, Mexicans were categorized as "white" according to the U.S. Census Bureau. Since then, however, Mexicans were given their own "racial" category. After protests of the Mexican government, Mexicans were again labeled as "white" in the three subsequent censuses. From 1970 on, the term "race" in association with skin color was omitted and substituted by the "cultural" category "Hispanics", meaning "a person of Cuban, Mexican, Puerto Rican, South or Central American or other Spanish culture or origin regardless of race" (Grieco and Cassidy, 2000). Thus, this example illustrates well how group demarcation highly depends on volatile political circumstances and negotiations.

6.1.2. Stereotypes

Stereotype-based explanatory models focus on circumstances of discrimination toward people because of "culture" (Chiao et al., 2008), skin color (Knutson et al., 2007; Richeson et al., 2003) or other features, such as facial physiognomy (Ronquillo et al., 2007). Such learned stereotypes are raised as an explanation for observed differences in neural activation patterns confronting different "cultural groups". Thus, in this case the processes of demarcation of groups are linked to socially acquired knowledge [e.g. regarding "racial" attitudes (Richeson et al., 2003), semantic associations (Ronquillo et al., 2007) and evaluations (Phelps et al., 2000)]. Accordingly, stereotypes about other "cultural groups" are regarded as the cause of neural activity increases, e.g. "[...] insular activation may be due partly to unpleasant feelings such as disgust (Krolak-Salmon et al., 2003; Wicker et al., 2003) experienced when white participants are presented with stereotypically black male names" (Knutson et al., 2007). Although such explanatory patterns provide the opportunity to consider the contingency of group evaluation, in the reviewed studies this is not realized, since biological foundations implying better evolutionary adaptation are presented: "People instantly categorize other people on the basis of social distinctions such as race, gender, and age. Such rapid and even automatic responses direct much of human cognition and behavior. The sensory and social world bombards people with information, so such adaptive shortcuts efficiently use their limited mental resources" (Wheeler and Fiske, 2005). According to this quotation, having

stereotypes about "racial groups" is not only viewed as advantageous in structuring everyday-life impressions (which must be questioned itself), but instead regarded as a necessity of human cognition. The automatism proclaimed within this process renders stereotypes as unavoidable and their social conditionality is thus displaced by their assumption of universal and automatic biological foundations.

6.1.3. Familiarity

In this subcategory the assumption that familiarity to group specificities prestructures one's behavior toward them is fundamental. Here, the demarcation of groups is related to group-referential learning, mostly based on the time spent in a "foreign culture" or years of customization to a "culture" as it is described, e.g. by Golby and co-workers: "From a young age, people usually have much more experience with faces from their own racial group (Chance et al., 1982). Such variation in social experience may contribute importantly to the development of visual expertise with faces" (Golby et al., 2001). Obviously, it is assumed that differences in behavior and cortical activation patterns toward people of another "race" are due to their apparent strangeness. Factors such as experience (Golby et al., 2001), exposure (Chiao et al., 2008), or perceptual expertise (Golby et al., 2001) are offered as explanations for the psychological reaction toward the outgroup. Thus, the idea of an original group living in a homogenous environment (assuming that, e.g. all Germans in Germany have the same experiences) is proposed. Similarly, this implies that the objects of experience must be more homogenous within a predefined group than between different groups. Again, such logic assumes resemblance among group-members, "tend[ing] to ignore variation within the group" (Choudhury and Kirmayer, 2009).

6.2. Differentialism and culture

Studies quoted in this category focus on a "body of background traits that are automatically imprinted and expressed in every individual of a certain culture" (Vogeley and Roepstorff, 2009). In differentiability-based approaches, "culture" is itself the subject of analysis. Here, "cultural" knowledge or practices implicate a variation of behavior and, accordingly, distinct neural activation patterns in CN. Differentiability-based argumentations have already been applied in cultural psychology. In this regard, Oyserman and colleagues elaborated on methodological issues regarding the loose handling of cultural constructs in "the overly broad and diffuse ways researchers define and assess these constructs and their apparent willingness to accept any cross-national difference as evidence of individualism and collectivism processes" (Oyserman et al., 2002). A more theoretical critique is raised by Miller who states that "attention must be paid to the heterogeneity of cultural meanings and practices across contexts as well as within populations. Equally, it is important to recognize that cultural meanings and practices shift in complex ways over historical time" (Miller, 1997).

These issues recur in CN studies as well. However, the direct link to up-to-date biotechnology (here fMRI examinations) strengthens a biologized view on "culture". Therefore, findings in this field of research exert a tremendous impact on the reproduction of stereotypes and racism.

The mentioned issues are prominent in both of the following subcategories; their respective additional argumentative peculiarities are discussed below.

6.2.1. Biological explanatory models

In this category, "cultural" experiences and differences are understood in biological terms. For example, Ronquillo and colleagues write that "one theory of racial bias states that White Eurocentric phenotypic characteristics (e.g. lighter skin and eye color,

longer and straighter hair, narrower nose and thinner lips) are preferable to features toward the opposite end of the continuum (e.g. darker skin, kinkier hair, broader nose and fuller lips; Maddox, 2004)" (Ronquillo et al., 2007). Whereas in this quotation the authors assign physical appearances to "racial categories", which is picked up on below to explain differences in functional activation measures, other authors directly link the concept of race to distinct brain functions. Accordingly, Zhu and colleagues assume that different neural substrates underlie the self in Western vs. Eastern "cultures" and state that their "results suggest that Western independent self is mediated by unique neural substrates, whereas East Asian (e.g. Chinese here) interdependent self depends on overlapping of neural substrates for the self and close others" (Zhu et al., 2007). Moreover, Moriguchi and co-workers suggest different visual processing pattern between Caucasian and Japanese individuals in identifying fearful faces, e.g. "a template-matching process for facial recognition might be related to the 'mirror neuron' system. [...] During observation of fearful faces, we propose that Japanese subjects may utilize a template matching system to identify the type of emotion expressed, whereas Caucasian subjects may more directly recognize faces as 'fearful', thus inducing stronger emotional responses. One would argue that the different brain activity patterns in the present study may reflect racial difference of visual processing pattern rather than that of emotional recognition patterns" (Moriguchi et al., 2005). In all examples, either referring to distinct physical attributes, which exert their impact on the neural correlates or directly to functional or structural brain differences, the classification of people into different groups is based on physiological features (including among others facial physiognomy (Moriguchi et al., 2005)). Here, the critique voiced by postcolonial and racism-theorists that sees a continuity between the colonial usage of the concept of "races" and modern approaches to "cultural diversity" must be applied (Taguieff, 1992). From this perspective, approaches to "cultural diversity", even though having overcome a system of "racial" hierarchies, share underlying assumptions that also originate from insurmountable differences (Brown, 1993). The idea of clearly definable "cultural" demarcations cements "cultural" belonging as essential, just as the biological concept of "race" did. This continuity becomes even more explicit when "cultural practices" are explained in biological terms. This perspective obviously resembles classic racist ideologies, substituting race with culture. We agree with Choudhury's and Kirmayer's statement that "attributing cultural difference to the brain made it intrinsic to the physical make-up of people, sidestepping the need to defend a historically contingent hierarchy of values, and ultimately serving explicitly racist ideologies" (Choudhury and Kirmayer, 2009).

6.2.2. Culturally acquired knowledge

Studies focusing on culturally acquired knowledge and practices most often keep the idea of "cultural totalities" as their starting point. These totalities are assumed to have specific characteristics that distinguish them from one another (i.e. see TO in Tables 2 and 3). Here, the accusation of essentializing cultural identity is similarly relevant. Especially studies that select national borders to demarcate "cultures" seem to blur contingent political situations with individual identity. Another kind of argumentation focuses not on national demarcations but on a binary structure between two main "cultural groups". Here, the idea is that the world is divided into two main groups, such as Eastern vs. Western (Chiao et al., 2009a; Zhang et al., 2006), which is exemplified among others by Zhu et al. (2007): "Additional brain structures linked to self- and mother-judgments, in Chinese, compared with Western individuals, provide further neuroimaging evidence for the interdependent self formed by East Asian culture". Further, independent vs. interdependent (Sui and Han, 2007; Zhu et al., 2007) or individualistic vs. collectivistic "cultures" "provide direct evidence that cultural val-

ues of individualism and collectivism influence neural mechanisms underlying the self" (Chiao et al., 2009a). Importantly, in all these explanation patterns the individual is just the anonymous representative for a "cultural totality", often implying a construction of a "Western perspective" which is contrasted to the "rest" (Hall, 2008). A Eurocentric perspective is thereby taken as a default, implying that Europe or the West is the owner of the Enlightenment's achievement of the conscious and rational individual. This is supported by critiques of (cross-) cultural psychology which often regards European Americans as the gold standard for, e.g. individualism, against which most cross-cultural comparisons are made (Bond, 2002; Oyserman et al., 2002). The cause of differences in neural activation patterns is speculated to lie in different regional or national practices, i.e. "the best explanation for members of the two cultures exhibiting increased activation in opposite task conditions is that each culture exhibits a preferred processing mode (relative for East Asians, absolute for Americans)" (Hedden et al., 2008). Similarly, different language systems accompanied by different processing strategies are hypothesized to account for differences in neural activation measures between "cultures", e.g. "it is possible that the Japanese ToM [Theory of Mind] task demanded orthography-related semantic analyses more than the English ToM task for children" (Kobayashi et al., 2007).

7. Looping effect

Science and knowledge always develop in a specific socio-historical situation from which categories and research questions are extracted (Rose, 2001a). In his article "The looping effects of human kinds", Ian Hacking states that such knowledge simultaneously generates new categories and new research fields (Hacking, 1995). Hacking labels the backlash of biologically driven explanations onto the social world as "looping effects" (Hacking, 1995). Related to the current review of CN studies, biological-evolutionary justifications for discriminatory behavior (universalism and culture) and the biology-driven segregation of "cultures" or the construction of a dichotomy between the East and the West (differentialism and culture), for example, are problematic, given the danger of reproducing and strengthening such categories. Moreover, such discourses always run the risk of self-referential biasing due to mutual citations. Thus, the truth of science is a constructive process which arises from a self-fulfilling and self-reproductive community. From this perspective, science never is neutral and always transports a concrete view of the world. The claim of being "descriptive rather than prescriptive" (Workman and Reader, 2004) is not sustained. Especially the quoted CN studies demonstrate in various respects the valuation of used categories, as "the narrower lens for the Americans may correspond more closely to a single target object. This type of focus would explain the special status of objects in cognitive processing (Davenport and Potter, 2004), as well as our finding of more distinct processing of objects for Americans" (Gutchess et al., 2006).

8. Conclusion

Our discussion reveals that the approaches to "culture" offered by CN are not neutral and are always tainted to some degree by specific political attitudes. In this article we reviewed scientific research studies which investigate the neural foundations of human "cultural phenomena" and aim at discovering how "human culture" is manifested in neural activation patterns. Our aim was to disclose their presumed and often unexamined implications and to expound on their socio-cultural consequences. Thus, we applied a categorical system, i.e. universalism and differentialism, and referred to critical issues within both categories. Main

results extracted from the quoted studies were their simplistic view on a biological foundation for the demarcation of “cultures” (i.e. universalism) as well as for “cultural” differences themselves (i.e. differentialism). By providing this overview, it is further revealed that most of the CN studies have an understanding of “culture” and “race” which still appeals to biology, blood and ancestry, indicating a transition from classical to cultural racism. Practically none of the quoted studies provided elaborate definitions of their object of investigation and, according to the typology introduced by Reckwitz (see above), most of the CN studies apply a totality-oriented approach to culture (see Tables 2 and 3; Concepts). For all these reasons, we suggest that the categories and results published in this area should be taken with caution.

In light of the present critique, similar issues stick to rising strands in the neurosciences such as the application of seemingly objective classifications of “cultural groups” by means of machine-learning algorithms (Ge et al., 2009), as well as to other research fields which, e.g. link infectious diseases (“*Can the common brain parasite, Toxoplasma gondii, influence human culture?*” (Lafferty, 2006)), imaging genetics (Kumakiri et al., 1999), or hormonal reactivity (De Dreu et al., 2011) to “culture”.

Finally, we would like to provide a critical reflection of our own research standpoint: we realize the influence of our scientific and personal background on the present analysis and its conclusions. Likewise, CN is rooted in a cultural context which defines the relevant research questions and topics. This cultural context is traversed by social circumstances, political interests, or balance of power. In this sense, we see ourselves as part of specific discourses which form our research and which are also formed by it.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.neubiorev.2011.05.006.

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