The Journal of Mind and Behavior

Vol. 34 No. 1 Winter 2013

ISSN 0271–0137

The Journal of Mind and Behavior (JMB) is dedicated to the interdisciplinary approach within psychology and related fields. Mind and behavior position, interact, and causally relate to each other in multidirectional ways; JMB urges the exploration of these interrelationships. The editors are particularly interested in scholarly work in the following areas: □ the psychology, philosophy, and sociology of experimentation and the scientific method □ the relationships among methodology, operationism, and theory construction □ the mind–body problem in the social sciences, psychiatry and the medical sciences, and the physical sciences □ philosophical impact of a mind–body epistemology upon psychology and its theories of consciousness □ critical examinations of the DSM–biopsychiatry–somatotherapy framework of thought and practice □ issues pertaining to the ethical study of cognition, self-awareness, and higher functions of consciousness in nonhuman animals □ phenomenological, teleological, existential, and introspective reports relevant to psychology, psychosocial methodology, and social philosophy □ historical perspectives on the course and nature of psychological science. We typically do not publish empirical research. The Journal also recognizes the work of independent scholars.

JMB is based upon the premise that all meaningful statements about human behavior rest ultimately upon observation — with no one scientific method possessing, a priori, greater credence than another. Emphasis upon experimental control should not preclude the experiment as a measure of behavior outside the scientific laboratory. The editors recognize the need to propagate ideas and speculations *as well as* the need to form empirical situations for testing them. However, we believe in a working reciprocity between theory and method (not a confounding), and in a unity among the sciences. Manuscripts should accentuate this interdisciplinary approach — either explicitly in their content, or implicitly within their point of view.

JMB offers a publication outlet on a quarterly basis. The Journal publishes one volume per year in the following sequence of issues: Winter, Spring, Summer, and Autumn. There are no submission fees or page costs for accepted manuscripts. JMB is a peer-reviewed, refereed journal, and all decisions will be made by the assessing editors, associate editors, and chief editors. Commentaries and responses to individual articles and reviews are welcome. Authors subscribing at the time of manuscript submission are eligible for reduced subscription rates (see below).

All manuscripts should follow the style and preparation presented in the *Publication Manual of the American Psychological Association* (sixth edition, 2010). Particular attention should be paid to the citing of references, both in the text and on the reference page. [Note exceptions to APA style: JMB uses *no* ampersands or city/state abbreviations in referencing; the Journal uses three levels of headings: level 1, level 3, and level 4, see pp. 113, 114, 115 from the fifth (2001) edition APA Manual.] Authors requesting blind review must specify and prepare their manuscripts accordingly. Manuscripts may be sent to the Editor either by e-mail to jmb@maine.edu or by post (one copy) to:

Raymond Chester Russ, Ph.D., Editor
The Journal of Mind and Behavior
Department of Psychology
The University of Maine
5742 Little Hall
Orono, Maine 04469–5742
Tel. (207) 581-2057

Yearly subscription rates are $32.00 for students or hardship; $35.00 for past/present JMB authors or for those submitting manuscripts; $46.00 for individuals; $185.00 for institutions. Air mail rates upon request. All back issues are available and abstracts are located at www.umaine.edu/jmb. For detailed information contact our Circulation Department at The Institute of Mind and Behavior, P.O. Box 522, Village Station, New York City, New York 10014; Tel: (212) 595-4853.

continued inside back cover

The Journal of Mind and Behavior

Editorial Board

Assessing Editors

The Journal of Mind and Behavior

Vol. 34 No. 1

Winter 2013

Library of Congress Cataloging in Publication Data

The Journal of mind and behavior. – Vol. 1, no. 1 (spring 1980)–
– [New York, N.Y.: Journal of Mind and Behavior, Inc.]
c1980–

1. Psychology–Periodicals. 2. Social psychology–Periodicals. 3. Philosophy–Periodicals. I. Institute of Mind and Behavior
BF1.J6575 150'.5 82-642121
ISSN 0271-0137 AACR 2 MARC-S

The Journal of Mind and Behavior

Winter 2013 Vol. 34 No. 1

CONTENTS

The Journal of Mind and Behavior
Winter 2013, Volume 34, Number 1
Pages 1–40
ISSN 0271–0137

The Use of the Classical Twin Method in the Social and Behavioral Sciences: The Fallacy Continues

Jay Joseph

Private Practice, Oakland, California

The classical twin method assesses differences in behavioral trait resemblance between reared-together monozygotic and same-sex dizygotic twin pairs. Twin method proponents argue that the greater behavioral trait resemblance of the former supports an important role for genetic factors in causing the trait. Many critics, on the other hand, argue that non-genetic factors plausibly explain these results. The twin method has been used for decades in psychology, psychiatry, and medicine, and more recently in social science fields such as political science and economics. In 2012, a team of researchers in political science using behavioral genetic methods performed a study based on twin data in an attempt to test the critics' position, and concluded in favor of the validity of the twin method and its underlying monozygotic–dizygotic "equal environment assumption." The author argues that this conclusion is not supported, because the investigators (1) framed their study in a way that guaranteed validation of the twin method, (2) put forward untenable redefinitions of the equal environment assumption, (3) used inadequate methods to assess twin environmental similarity and political ideology, (4) reached several conclusions that argue against the twin method's validity, (5) overlooked previous evidence showing that monozygotic twin pairs experience strong levels of identify confusion and attachment, (6) mistakenly counted environmental effects on twins' behavioral resemblance as genetic effects, and (7) conflated the potential yet differing roles of biological and genetic influences on twin resemblance. The author concludes that the study failed to support the equal environment assumption, and that genetic interpretations of twin method data in political science and the behavioral science fields should be rejected outright.

Keywords: behavioral genetics, equal environment assumption, political science, twin study

Researchers in psychology and psychiatry have used the "classical twin method" since the 1920s to assess whether genetic factors underlie psychological traits such as IQ and personality, and major psychiatric disorders such as schizophrenia and bipolar disorder. Because reared-together MZ (monozygotic,

Correspondence concerning this article should be addressed to Jay Joseph, Psy.D., P.O. Box 5653, Berkeley, California 94705–5653. Email: jayjoseph22@gmail.com

identical) pairs share 100% of their segregating genes, whereas reared-together DZ (dizygotic, fraternal) share on average only 50%, twin researchers have argued that the usual finding that MZ pairs resemble each other more for behavioral traits and disorders than do same-sex DZ twin pairs is caused by the former's greater genetic resemblance, thereby indicating that the trait or disorder has an important genetic component. From the very beginning (Siemens, 1924), the basic underlying assumption of the twin method has been that reared-together MZ and DZ twin pairs experience similar environments. This critical theoretical assumption (Scarr and Carter–Saltzman, 1979) is called the "equal environment assumption," or "EEA."

At the same time, most critics of the twin method have argued that MZ pairs experience much more similar environments than DZ pairs, and that this greater environmental similarity confounds genetic interpretations of twin method data.[1] As it turned out, by the 1960s most critics and many twin researchers alike agreed that research had shown what common sense already dictated: that MZ twin pairs experience more similar environments, are treated more alike, and are socialized to be more alike than are DZ pairs (Joseph, 2004). Indeed, as twin researchers Scarr and Carter–Saltzman (1979) concluded, "the evidence of greater environmental similarity for MZ than DZ twins is overwhelming" (p. 528). According to a 1978 account by behavioral genetic twin researcher John Loehlin, in his 1976 study he "found, as nearly everybody else has found who has investigated the point, that identical twins are indeed treated more alike — they are dressed alike more often, are more often together at school, play together more, and so forth" (Loehlin, 1978, p. 72). Others have pointed to MZs' greater psychological closeness, identity confusion, and "ego fusion" when compared with DZ pairs (Dalgard and Kringlen, 1976; Husén, 1959; Jackson, 1960; Joseph, 2004; Koch, 1966; Kringlen, 1967; Shields, 1954). In the words of twin researcher Ricardo Ainslie (1997), "twins often encounter ambiguity and confusion with respect to their sense of identity" (p. 2).

The "Fallacy" of the Twin Method

For most critics, it was by now crystal clear that the twin method was based on the "fallacy" that MZ and DZ environments were equal (Bleuler, 1978, p. 432; Penrose, 1973, p. 90; Stocks, 1930, p. 104). Several leading twin researchers and psychologists studying behavior and personality in the postwar era were themselves unsure of the validity of the equal environment assumption. For example, according to schizophrenia twin researcher Pekka Tienari,

[1]My own first attempt to articulate this position appeared in this journal in 1998 (Joseph, 1998).

> It is doubtful . . . whether the difference in concordance rate between identical and fraternal groups of twins can, as such, be ascribed to hereditary factors. In all likelihood, the environment, too, is more similar in the case of identical than in the case of fraternal twins . . . . Furthermore, it is obvious that the intensity of the mutual relationship of identical twins is considerably greater than that of siblings in general and, also, of fraternal twins . . . . It is apparent that differences in concordance rates between groups of identical and fraternal twins, as well as between female and male twin pairs, are partly attributable to environmental (psychological) factors. (Tienari, 1963, pp.119–121)

In his twin study of personality, Irving Gottesman (1963) recognized that although the twin method "assumes that the within-pair environmental variance is the same for the two types of twins," the equal environment assumption "is not necessarily true for the personality traits as measured by the tests, but one can proceed only on the assumption that such variance is not too different for the two types of twins" (p. 8). Given the difference in variance, Gottesman could have decided not to proceed, or could have chosen a more modest title than the one he eventually chose: "Heritability of Personality: A Demonstration."[2]

Mid-1960s researchers in the fields of behavioral genetics, psychiatric genetics, and medical genetics were presented with a major problem, since their theories and claims in favor of the importance of heredity, and at times advocacy of eugenic policies (Joseph, 2004), were based primarily on twin method data (and family study data). Yet, the evidence strongly suggested that the equal environment assumption — as it had been defined until then — was false. This indicated that conclusions in favor of genetics based on twin studies (as well as family studies) were confounded by environmental factors, suggesting that the twin method should have been discarded as an instrument for the detection of genetic influence.

We will see, however, that despite several devastating and never-refuted critiques of the twin method (most notably, Jackson, 1960), twin researchers were successful in preserving the twin method mainly on the basis of (1) using circular arguments; (2) changing the definition of the equal environment assumption; and/or (3) denying, ignoring, or downplaying the evidence that MZ and DZ environments are different (Joseph, 2004, 2010a, 2012; Lewontin, Rose, and Kamin, 1984; Pam, Kemker, Ross, and Golden, 1996).

Thus, in the twenty-first century the "fallacy" of the twin method and its untenable equal environment assumption live on as twin studies, and their authors' conclusions that they prove something about genetic influences on behavioral traits, continue to be published in leading journals and textbooks in psychology, psychiatry, and other fields, with little critical analysis. More recently,

---

[2]Around the same time, founding behavioral genetic researcher Gerald McClearn expressed doubts similar to Gottesman's (1963) about the validity of the equal environment assumption, yet the chapter in which he expressed these doubts was entitled "The Inheritance of Behavior" (McClearn, 1964).

researchers in the fields of political science and economics have used twin method data to argue in favor of an important role for genetic factors in their respective fields (e.g., Alford, Funk, and Hibbing, 2005; Cesarini, Johannesson, Wallace, and Lichtenstein, 2009), and have created the subfields of "genopolitics" and "genoeconomics."

Here I focus on an attempt by Kevin Smith and a group of leading political scientists, which include John Alford, Peter Hatemi, Carolyn Funk, John Hibbing, and veteran behavioral genetic twin researcher Lindon Eaves (Smith, Alford, Hatemi, Eaves, Funk, and Hibbing, 2012) to uphold the validity of the equal environment assumption and the twin method in the face of challenges both from within their field (Charney, 2008a, 2008b; Suhay, Kalmoe, and McDermott, 2007), and outside of their field (Beckwith and Morris, 2008; Joseph, 2010b). Indeed, Alford, Funk, and Hibbing (2005) had previously written, correctly, that the equal environment assumption "is crucial to everything that follows from twin research" (p. 155).

The analysis I present here is relevant to twin research in psychology, psychiatry, and the social and behavioral sciences in general. All studies I discuss and analyze are based on samples of twin pairs reared-together in the same family, which form the basis of twin method investigations.[3]

Two Arguments in Defense of the Twin Method and the Equal Environment Assumption

Argument A

Since the 1960s, twin researchers have defended the validity of the twin method on the basis of two main arguments, sometimes invoking both arguments at the same time.[4] What I will call here *Argument A* states that although MZ environments are more similar than DZ environments, the twin method retains its validity because MZ pairs "create" or "elicit" more similar environments for themselves because they are more similar genetically. Elsewhere I have called

[3]I do not discuss "twins reared-apart" studies here, mainly because Smith and colleagues (2012) did not cite them in support of the twin method. Other political science twin study publications have cited these studies in support of the twin method (e.g., Alford et al., 2005), and elsewhere I have discussed the many potentially invalidating problems found in reared-apart twin studies (see Joseph, 2004, 2010a, 2010b; see also Kamin, 1974).

[4]At times, genetic researchers and their supporters ignore the equal environment issue altogether (thereby tacitly accepting twin method assumptions), or simply deny that MZ and DZ environments are different. As an example of the latter position, in his book *Mood Genes*, psychiatric genetic researcher Samuel Barondes wrote, "Assuming that the shared environments of sets of identical twins and sets of fraternal twins are roughly equal (which appears to be the case), comparing their degree of similarity gives an indication of the relative contributions of nature and nurture" (Barondes, 1998, p. 81).

this the "twins create their own environment theory" (Joseph, 1998). Five examples of the Argument A defense of the equal environment assumption (EEA) read as follows:

> It has been argued that the environmental difference of monozygotic twins is reduced because they tend to seek similar environments; however, in so far as they do this because of their genetic similarity rather than just to copy one another, their behaviour is a reflection of their genotype and must be regarded as influencing their genetic rather than their environmental variance. (Bulmer, 1970, p. 144)

> A series of ingenious studies . . . have all pointed to the conclusion that, for the most part, the more similar treatment of MZs is not the cause of their greater phenotypic similarity but, rather, a consequence of their genetic identity and the more similar responses this elicits from the environment. (Martin, Boomsma, and Machin, 1997, p. 390)

> A subtle, but important, issue is that identical twins might have more similar experiences than fraternal twins because identical twins are more similar genetically. Such differences between identical and fraternal twins in experience are not a violation of the equal environments assumption because the differences are not caused environmentally. (Plomin, DeFries, McClearn, and McGuffin, 2008, p. 79)

> Critics of the classic twin design cite a number of alleged failures of the equal environment assumption. A common theme of these criticisms is that MZ twins receive more similar treatment . . . . It is important to emphasize that even if MZ twins are treated more similarly, this does not in and of itself constitute a violation of the assumption; greater similarity in environment may be caused by the greater similarity in genotypes. (Cesarini et al., 2009, p. 621)

> It is important to note that if MZ twins are treated more alike than DZ twins, it is most likely associated with their genetically based behavioral similarities. (Segal and Johnson, 2009, p. 82)

In addition, the following passage appeared in a 2010 twin study published in a political science journal:

> If MZ twins are treated more similarly because they are biologically more alike, this can hardly be considered a violation of the EEA. For the reason that MZ environments are more similar than DZ environments (if indeed they are) is *because of the initial difference in genetic predispositions.* (Sturgis et al., 2010, p. 222, emphasis in original)

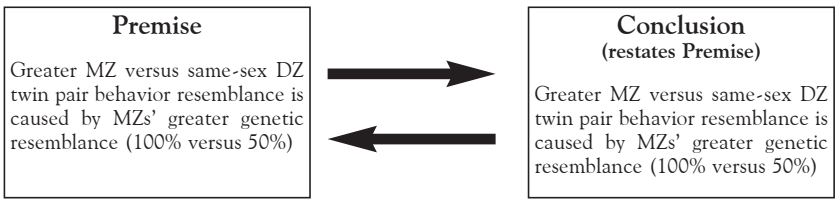
Many other leading behavioral genetic researchers have defended the validity of the twin method on the basis of Argument A (for example, Flint, Greenspan, and Kendler, 2010; Kendler, 1983; Loehlin and Nichols, 1976; Rose, 1991; Rutter, 2006; Scarr and Carter–Saltzman, 1979; Vandenberg, 1966).

Although twin researchers have used Argument A consistently since the 1960s (for more examples, see Joseph, 2012), I have shown elsewhere that this is a circular argument, because twin researchers' conclusion that MZ–DZ differences are explained by genetics is based on assuming the very same thing (Joseph, 2010a,

2012). In other words, as seen in Figure 1, twin researchers using Argument A simultaneously and circularly assume and conclude that the greater behavioral trait resemblance of MZ versus DZ twin pairs is caused by the former's greater genetic similarity, and their position that genetic factors explain the greater behavioral resemblance of MZ twin pairs is both a *premise and a conclusion* of twin studies.

Circular reasoning has been defined as "empty reasoning in which the conclusion rests on an assumption whose validity is dependent on the conclusion" (Reber, 1985, p. 123). A circular argument consists of "using as evidence a fact which is authenticated by the very conclusion it supports," which "gives us two unknowns so busy chasing each other's tails that neither has time to attach itself to reality" (Pirie, 2006, p. 27). As seen in Figure 1, the Argument A premise and conclusion are the same — that MZs' greater genetic resemblance causes their greater behavioral resemblance — and they are too busy "chasing each other's tails" to provide any evidence in favor of genetics.

According to the psychologist Lance Rips, in circular arguments, "the arguer illicitly uses the conclusion itself . . . as a crucial piece of support, instead of justifying the conclusion on the basis of agreed-upon facts and reasonable inferences." He concluded, "A convincing argument for conclusion c can't rest on the prior assumption that c [is correct], so something has gone seriously wrong with such an argument" (Rips, 2002, p. 767). In their attempts to answer



Example

"The similar phenotypes in monozygotic twins are caused by their genetic similarity. The similar phenotypes of these twins are then responsible for creating their similar social environment."

—Psychiatric genetic twin researcher Kenneth Kendler (1983, p. 1414) arguing in defense of the equal environment assumption and the twin method

Figure 1: Circular reasoning used consistently since the 1960s in support of the twin method. Twin researchers' Argument A. Figure modified from Jay Joseph (2012), "The 'Missing Heritability' of Psychiatric Disorders: Elusive Genes or Non-Existent Genes?" *Applied Developmental Science, 16*(2), p. 71. © 2012 Taylor & Francis Group, New York.

the critics' objections, in Figure 1 we see that twin researchers invoke Argument A as they refer to the premise in support of the conclusion, and then refer back to the conclusion in support of the premise, in a continuously circular loop of faulty reasoning.

An additional problem with Argument A is that, even if true, MZ pairs could still resemble each other more than DZ pairs for psychiatric disorders and medical conditions for purely environmental reasons. For example, MZ twin pairs with equal genetic predispositions for enjoying tennis would probably correlate higher than DZ pairs for tennis elbow, but this condition would not be caused by any genes for tennis elbow. A final problem with Argument A is that it portrays twins as behaving according to an inherited environment-creating blueprint, but portrays *parents* as easily able to change their behavior and treatment in response to their twins' behavior — in effect being flexible enough to allow their twins to "create their own environments." However, according to the logic of Argument A, parents' "environment-creating" behavior and personalities should be far more unchangeable than their children's because, in addition to their presumed genetic predispositions, adults have experienced decades of behavior-molding peer, family, religious, and other socialization influences. Thus, the Argument A defense of the equal environment assumption is based on a "seriously wrong" error in reasoning, in addition to other problems, and we must therefore reject it as a valid argument in support of the twin method.

Argument B

Like supporters of Argument A, proponents of what I will call *Argument B* (the "trait-relevant" qualification) recognize that MZs experience more similar environments than DZs, but argue that, in order to invalidate the equal environment assumption, it must be shown that MZ and DZ environments differ in respects that are relevant to the trait in question. This is known as the "equal trait-relevant environment assumption" (Carey and DiLalla, 1994), and is seen in the following definition of the equal environment assumption by a group of leading psychiatric twin researchers:

> The traditional twin method, as well as more recent biometrical models for twin analysis, are predicated on the equal-environment assumption (EEA) — that monozygotic (MZ) and dizygotic (DZ) twins are equally correlated for their exposure to environmental influences *that are of etiologic relevance to the trait under study*. (Kendler, Neale, Kessler, Heath, and Eaves, 1993, p. 21, emphasis added)

And according to behavioral genetic investigators Thomas Bouchard and Matt McGue, two key researchers in the Minnesota Study of Twins Reared Apart (MISTRA):

> Behavioral geneticists call this assumption the "equal environmental similarity assumption," a term that is somewhat misleading in that the issue is not whether [reared together] MZ twins experience more environmental similarity than DZ twins, but rather whether they are more likely to share trait-relevant features of their environments. (2003, p. 9)

In political science, researchers sometimes define the assumption on the basis of Argument B. According to Hatemi and McDermott,

> The [twin method] approach relies on several assumptions. The most contested, yet dependable, is that the familial environment influences the examined trait to the same degree for MZ and DZ twins. (2012, p. 528)

And Medland and Hatemi (2009) wrote that, while "there is little argument that MZ twins are treated more similarly than DZ twins in certain aspects," one of the "central questions of the equal environment assumption (EEA)" is "whether these differences influence the specific trait under analysis" (pp. 198–199).

To the best of my knowledge, Argument B was first put forward in the mid-1960s, without explanation or theoretical justification, by twin researchers Gottesman and Shields. These investigators wrote that, in schizophrenia twin studies, the equal environment assumption would be wrong if "the environments of MZ twins are systematically more alike than those of DZ twins in features which can be *shown* to be of etiological relevance in schizophrenia" (Gottesman and Shields, 1966, pp. 4–5, emphasis in original). In defining the assumption using this new trait-relevant formulation, Gottesman and Shields appeared to place the burden of proof on critics to "show" that the environments differ in trait-relevant aspects.

Although other twin researchers frequently (yet wrongly) place the burden of proof on critics for demonstrating that MZ pairs experience more similar trait-relevant environments than DZ pairs (e.g., Alford, Funk, and Hibbing, 2008; Bouchard, 1993; DeFries and Plomin, 1978; Faraone and Biederman, 2000; Lyons, Kendler, Provet, and Tsuang, 1991), at other times, such as the Smith et al. study I will review shortly, twin researchers attempt to test the equal environment assumption for environmental bias (for critical reviews of the equal environment test literature, see Felson, 2009; Joseph, 2006; Pam et al., 1996; Richardson and Norgate, 2005).

As seen in Kendler and colleagues' Argument B definition above, the MZ–DZ equal environment assumption also underlies more complex biometrical analyses based on twin data, which attempt to partition genetic (A), "shared environment" (C), and "unshared environment" (E) contributions to trait variation in a population (the "ACE Model"; see Medland and Hatemi, 2009). It is therefore important to emphasize that regardless of the apparent complexity of the statistical formulations, path diagrams, twin family designs, "Cholesky decompositions," and covariance matrices that researchers put forward, the "dazzling statistical

pyrotechnics" (Lerner, 1995, p. 148) they often present depend — in the final analysis — on the validity of the MZ–DZ equal environment assumption. The assumption is the potential Achilles heel of the twin method, as well as of all statistical calculations and models based on twin method MZ–DZ comparisons.

Argument A Potentially Renders Argument B Irrelevant

An example of an Argument B environmental factor relevant to a trait or disorder is the relationship between exposure to trauma and post-traumatic stress disorder (PTSD). Because trauma exposure is (by definition) an environmental factor known to contribute to the development of post-traumatic stress disorder, a finding that MZ pairs are more similarly exposed to trauma than DZ pairs means that MZs experience more similar "trait-relevant" environments than DZs. Many twin researchers using Argument B would conclude that the equal environment assumption is violated in this case.

Interestingly, the Argument A position that twins create their own environments because they are more similar genetically potentially renders Argument B irrelevant because, even if critics or researchers show that MZ pairs experience more similar "trait-relevant" environments than DZ pairs, twin researchers could still argue in favor of the validity of the twin method and the equal environment assumption on the basis of MZ pairs having "created" or "elicited" more similar "trait-relevant" environments for themselves.

For example, in a twin study of posttraumatic stress disorder (PTSD) among combat veterans, William True and his colleagues (1993) found that MZ pairs did indeed experience more similar posttraumatic stress disorder trait-relevant combat experiences than did the DZ pairs (combat experience correlations were MZ r = .34, DZ r = .17; p. 258).[5] However, these twin researchers concluded that "inheritance makes a substantial contribution to PTSD symptoms" based on their Argument A claim that "inherited factors . . . increase the likelihood of exposure to traumatic events and responding to exposure by developing PTSD" (True et al., 1993, p. 263). The researchers therefore chose to conclude that their results supported a genetic basis for posttraumatic stress disorder, despite the finding that their MZ pairs experienced more similar trait-relevant combat experiences than experienced by the DZ pairs.

Another group of twin researchers explicitly stated that, even if trait-relevant environmental influences are found, the "twins create their own environment" argument would trump this finding and validate the twin method:

> It has been shown that MZ twins in childhood more often share playmates, share the same room, and dress more alike than same-sex DZ twins . . . . However, this does not

[5]I thank Roar Fosse for bringing this study to my attention.

> necessarily imply that the EEA is violated. First, the greater environmental similarity in MZ than DZ twins does not have to be related to a greater phenotypic similarity. Second, even if a greater environmental similarity is related to a greater phenotypic similarity, this association could be mediated by a greater genetic similarity in MZ than DZ twins. (Derks, Dolan, and Boomsma, 2006, p. 403, emphasis in original)

Like most twin researchers, Derks et al. recognized that MZ and DZ environments are different. In the language of the present review, they then wrote that even if Argument B does not hold, researchers could still fall back on Argument A and validate the twin method, because the trait-relevant environmental "association could be mediated by a greater genetic similarity in MZ than DZ twins." For this and other reasons, the validity of the equal environment assumption — and therefore of the twin method itself because it is based on the validity of the assumption — rests mainly on the acceptance or rejection of the "twins create their own environment" Argument A.

Family Studies and the Twin Method

It is noteworthy that twin researchers and behavioral geneticists do not make the "trait-relevant" or "create their own environment" arguments when discussing potential environmental confounds in *family studies*, despite the fact that both family studies and the twin method compare groups experiencing very different environments. That is, most behavioral genetic researchers recognize that family members share much more similar family and physical environments than shared by randomly selected members of the population, and recognize that MZ pairs share much more similar environments than shared by DZ pairs. However, they approach the unequal environments in each type of study very differently. Table 1 shows the differing ways that most leading behavioral geneticists approach and interpret family study data, versus the ways they approach and interpret data produced by twin method MZ–DZ comparisons.

In Table 1 we see that most behavioral genetic researchers recognize that the comparison groups in both family studies and twin studies experience different environments. In the case of family studies, they make no qualifications about how they should interpret data derived from these differing environments — the simple recognition that the environments are different is enough to invalidate genetic inferences based on family studies. Leading behavioral genetic researchers such as Robert Plomin and colleagues then unambiguously conclude, "family studies by themselves cannot disentangle genetic and environmental influences" (Plomin et al., 2008, p. 151).

However, with the twin method and *its* differing environments, behavioral geneticists usually invoke Argument A and/or Argument B and conclude the opposite — that the twin method is one of the "workhorses of human behavioral genetics that help to disentangle genetic and environmental sources of familial

Table 1

Differing Behavioral Genetic Interpretations of Research Findings: Family Studies versus Twin Studies

Type of Study	Environments of Comparison Groups	Qualifications Invoked by Behavioral Geneticists	Conclusions Reached by Most Behavioral Geneticists
FAMILY STUDIES	**Different:** Family members experience much more similar environments than those experienced by members of the general population	**None** (No claim that family members create or elicit more similar environments for themselves because they are more similar genetically; no requirement that family members must be shown to experience more similar *trait-relevant* environments than those experienced by members of the general population; no denial that families share a common environment as well as common genes)	**Unable** to disentangle potential environmental and genetic factors Therefore, a family study by itself provides no conclusive evidence in support of genetics **"Many behaviors 'run in families,' but family resemblance can be due to either nature or nurture."** (Plomin et al., 2008, p. 70)
THE TWIN METHOD	**Different:** Reared-together MZ twin pairs experience much more similar environments than those experienced by reared-together same-sex DZ pairs	1) **Argument A:** MZ pairs create or elicit more similar environments for themselves because they are more similar genetically, and/or 2) **Argument B:** it must be shown that MZ twin pairs experience more similar trait-relevant environments than those experienced by DZ pairs (behavioral geneticists usually conclude that this has not been shown), or 3) **Ignoring or denying:** failure to address the issue of MZ and DZ environments (thereby tacitly accepting twin method assumptions), or occasional claims that the environments are not different	**Able** to disentangle potential genetic and environmental factors Therefore, the twin method by itself provides conclusive evidence in support of genetics **"The twin method is a valuable tool for screening behavioral dimensions and disorders for genetic influence."** (Plomin et al., 2008, p. 80)

resemblance" (Plomin et al., 2008, p. 38). Thus, whereas behavioral genetic researchers rightly see family studies as *unable* to disentangle potential genetic and environmental influences, they see the twin method as *able* to disentangle these influences. In doing so, however, these researchers arbitrarily choose to apply a standard to family studies that they choose not to apply to the twin method, and then arrive at entirely different conclusions about each key research method.

The error lies in the contrasting behavioral genetic evaluations of family studies and the twin method. As some critics have argued, there should be no such contrast because these two research methods are equally unable to disentangle the potential influences of genes and environment. Thus, because the comparison groups in both types of studies experience very different environments, both must be assessed in the same way.

A 2012 Defense of the Equal Environment Assumption in Political Science

Beginning with a twin study of political attitudes and ideology published in 2005 (Alford et al., 2005), the political science field has seen a major growth of genetic research.[6] The investigators' conclusions have been highlighted in the popular press and in leading scientific journals (e.g., Buchan, 2012). At the same time, we have seen that critics both within and without of political science have argued that the equal environment assumption is not supported by the evidence. In addition, political scientist Evan Charney (2012) has shown that many previously accepted biological and genetic assumptions underlying twin research may not be true. Indeed, these findings "are necessitating a rethinking of every one of the assumptions of the classical twin study methodology" (Charney and English, 2012, p. 1).

Molecular genetic researchers in political science also claim to have located specific genes that influence political behavior (Fowler and Dawes, 2009; Hatemi et al., 2011). Like similar subsequently non-replicated claims in psychiatry and psychology over the past four decades, however, these findings are unlikely to be replicated (Charney and English, 2012; Joseph, 2010b, 2011, 2012; Plomin, 2013; Wahlsten, 2012). Indeed, in 2012 a team of leading molecular genetic researchers in the social sciences noted the failures to replicate, and, while continuing to believe that genes for political and economic behaviors and attitudes exist, concluded that they need possibly unattainably large samples: "It is likely that extremely large — perhaps impractically large — samples will be required" (Benjamin et al., 2012, p. 8030). In another publication, political scientists Hatemi and McDermott recognized that, for political traits, "replication of

[6]In political science, the twin method is frequently called the "CTD," or "classic twin design."

genome-wide, candidate gene and gene-environment interaction studies is almost nonexistent" (2012, p. 530).

The failure at the molecular genetic level to identify any genes that underlie political traits means that the argument in support of genetic theories in political science is based mainly on inferences drawn from twin data. Given the arguments of the critics and the understandable reluctance of many social scientists to accept the position that important genetic influences underlie political ideology and behavioral traits in general, Kevin Smith and his colleagues (see Smith et al., 2012) published a study whose results, they argued, supported the validity of the equal environment assumption and the twin method in political science and indicated, at least to some degree, that "political attitudes are inherited" (p. 17). The investigators seemed puzzled that despite the "consistency" of twin study results, "their [twin studies'] validity has been consistently challenged on a number of key issues" (p. 18). What many critics argue, however, is that twin researchers have *consistently misinterpreted* the results of twin studies in favor of genetics.

Smith and colleagues wrote that the critics' "central argument" is that studies using the twin method "inflate heritability estimates and do not accurately account for environmental-based sources of variance in political attitudes due to several specific shortcomings in the model" (p. 19). In fact, some critics have entirely rejected the validity of heritability estimates in the social and behavioral sciences (e.g., Lewontin, 1987; Moore, 2001; Rose, 1997), and also argue that (in addition to other sources of bias) in most cases MZ–DZ comparisons measure nothing more than the environmental factors that make MZ pairs resemble each other more than DZs for the psychological trait or psychiatric condition in question (see Joseph, 2004, 2010a).

Smith et al. wrote that criticism of the twin method is "made on the basis of secondary analysis of published research, not on the basis of empirical examination of CTD [twin method] assumptions on political variables" (p. 19). Although this is largely true, the researchers, like many other twin researchers past and present, imply that because critics usually do not study twins directly, researchers' conclusions carry more weight than those of the critics. However, the obvious and understandable bias of twin researchers in favor of the validity of twin research suggests that the opposite could also be true — that because most critics have no professional, collegial, or emotional stake in supporting the validity of twin research, from this distance they are able to provide a more realistic appraisal of this research, including especially its most important underlying theoretical assumptions.

An Approach That Guaranteed the Validity of the Twin Method

In the abstract of their publication, whose stated purpose was to assess the validity of environmental explanations of MZ–DZ behavioral trait differences,

Smith and colleagues (2012) wrote that even if the critics are "wholly correct" that the causes of MZ–DZ differences are "exclusively environmental," this finding would "provide reasons for political science to pay more rather than less attention to the biological basis of attitudes and behaviors" (p. 17). Thus, the investigators assured themselves and their readers that the validity of the twin method would be upheld by setting up a "heads I win, tails you lose" scenario whereby, regardless of what they found, the twin method and biological explanations of political behavior would retain their importance.[7] It is illogical, however, to state that political scientists should "pay more attention" to biological influences on political attitudes and behaviors if explanations for MZ–DZ differences are "wholly environmental."

In their concluding remarks, Smith and colleagues wrote that they had examined the arguments of the critics (actually, only the 2007 critique of Suhay et al.) and "found them wanting" (p. 30). They wrote that even if the arguments of critics were "empirically valid, the evidence from those studies, combined with molecular, physiological, neurological, and other studies provides good reason for political science to take biology (not just genes) seriously as a basis for explaining attitudes and behaviors" (p. 30). However, the validity of the twin method must stand or fall on its own merits, and cannot be validated in the context of claiming that it is part of a supposed converging set of evidence in support of biology and genetics (Joseph, 2006).

We have seen that, if the position of some critics that MZ–DZ differences are caused solely by environmental factors is "wholly correct," it is illogical for Smith et al. to argue that MZ–DZ comparisons supply evidence in support of biology and genetics. Quite the opposite is true: if these critics are correct, we can safely assume that twin studies of human behavioral traits measure nothing other than environmental influences (and potential research bias). It is certainly true that biology plays a role in everything human beings do, but Smith et al. invoked this obvious fact in support of the importance of biological and genetic approaches to the study of human variation in political behavior and attitudes. Self-evidently, one could invoke this argument in support of a genetic and biological approach to *any* aspect of the human condition. The researchers utilized this argument in the process of mistakenly conflating genetic causation and biological causation (see below) as they attempted to shore up the massive theoretical leaking ship that is the twin method.

[7]This also occurred in a 1998 behavioral genetic adoption study (Plomin, Corley, Caspi, Fulker, and DeFries, 1998), where the researchers found a .01 personality test correlation between birthparents and their 240 adopted-away biological offspring, yet concluded that their results supported an important genetic basis for personality (Joseph, 2013).

Smith and Colleagues Respond to the Critics

As we will see, one method Smith and colleagues (2012) used to uphold the validity of the twin method and the equal environment assumption was the transformation of environmental influences that cause MZ pairs to resemble each other more than DZ pairs into genetic influences. In the process, their conclusions about the validity of the twin method and the arguments of critics varied considerably. At some points they concluded that they "find little support" (p. 17) for the arguments of the critics, that they found these arguments "wanting" (p. 30), and that "political attitudes are inherited" (p. 17). At other times Smith et al. conceded that the critics are correct on certain points, and that their own "DZ findings may lend credence to criticisms that heritability estimates . . . from CTD [twin method] studies should be taken with a grain of salt" (p. 23).

Smith et al. concluded,

> Our analyses . . . strongly support the inference that nothing in the EEA critique credibly supports a claim that genetic influence on political temperament is nonzero or nontrivial. Additionally, our analyses find nothing to suggest that heritability estimates from CTD [twin method] studies on political traits are misleading or unduly biased. At a minimum, the undisputed patterns of ideological similarity between MZ and DZ twins do not seem to be fully explained by the mechanisms proposed by EEA critics. Our analyses provide little reason to expect points 1 and 2 [that MZ pairs have more similar experiences, and experience greater mutual influence], individually or in combination, to provide a wholly environmental explanation for observed MZ–DZ differences in ideological similarity. (2012, p. 30)[8]

Thus, Smith and colleagues' defense of the equal environment assumption boiled down to their conclusion that the twin method is not *entirely* confounded by environmental factors. However, the assumption can only be true if genetic factors explain virtually *all* of the observed greater resemblance of MZ versus DZ twin pairs for the behavioral trait in question. Smith and colleagues' recognition that at least part of this greater resemblance is caused by non-genetic factors leads to the conclusion that many critics have reached for decades — that, like family studies, the twin method is unable to disentangle the potential influences of genes and environment. Smith and colleagues' conclusion that "ideological similarity between MZ and DZ twins do not seem to be fully explained by the mechanisms proposed by EEA critics" is hardly a ringing endorsement of the twin method. In fact, it could serve as the epitaph of the twin method.

---

[8]In this quotation, Smith et al. wrote that critics argue that genetic influence on political temperament is "nonzero or nontrivial," when from the context they appear to have meant "zero or trivial." I thank M.C. Jones for bringing this to my attention.

Smith et al. (p. 23) argued that their results "clearly indicate" that the greater environmental similarity of MZ pairs "cannot account for all MZ–DZ differences." However, to accept the validity of the equal environment assumption we must assume that environmental factors explain virtually *none* of the difference. Thus, some critics of the twin method agree that genetic interpretations of twin method data should "be taken with a grain of salt," while others demand the outright rejection of genetic interpretations of twin method data.

The investigators also confused the requirement of the twin method that environmental factors have little or no influence on the behavioral trait resemblance of MZ versus DZ twin pairs, with whether environmental factors influence the trait itself. Variation in behavioral *traits* (political ideology, I.Q., schizophrenia, personality, economic behavior, and so on) could theoretically be caused by both genetic and environmental factors, but the *research method* used to establish the genetic component must be largely free from environmental contamination. Clearly, as Smith and colleagues recognized, the twin method is contaminated by environmental influences. They argued only that the twin method is not *completely* contaminated by these influences.

Defining the Equal Environment Assumption

During the first 45 years of the twin method (roughly 1924 to 1969), most twin researchers defined the equal environment assumption — without qualification — as the assumption that MZ and DZ pairs experience roughly equal environments. Some examples of twin researchers' non-qualified definitions of the assumption during this period are presented below (the term "nature" refers to genetic (inherited) influences; "nurture" refers to environmental influences):

> "It has been assumed that the mean nurture difference . . . is the same for identical and fraternal twins" (Holzinger, 1929, p. 244).

> The twin method "Assum[es] that environmental differences are the same for both identical and fraternal twins" (Newman, Freeman, and Holzinger, 1937, p. 21).

> "The [twin] formulas usually involve the assumption that the nurture influences are approximately equal for fraternal and identical twins" (Carter, 1940, p. 246).

> "The 'twin method' developed in Germany . . . and much used here in the last two decades for the study of heredity and environment . . . . [rests] on the assumption that the environment is as similar for a pair of fraternals as for a pair of identicals" (Woodworth, 1941, p. 9).

> One assumption of the twin method is "that nurture influences are the same for both types of twins" (Eysenck and Prell, 1951, p. 461).

> "In the comparison of MZ with DZ twins the assumption is made that the individual members of a twin-pair enjoy comparable or equivalent environments" (Neel and Schull, 1954, p. 280).

> The twin method assumes "That the 'average nurture difference' is the same for the two types of twins" (Jones, 1955, p. 102).

> "Research workers, who have endeavored to determine the 'shares' of nature and nurture in observed trait variations, have assumed the *environmental variance* to be the same for MZs and DZs in groups of twins that were reared together" (Husén, 1959. pp. 17–18, emphasis in original).

> "An underlying assumption [of the twin method] has been that the environments of the members of the identical pairs are not, on the average, more similar than those of the members of the fraternal pairs" (Tienari, 1963, p. 10).

> The twin method assumes that "The within-pair environmental variance is the same for the two types of twins" (Gottesman, 1963, p. 8).

> "The traditional use of the twin method entails the assumption that the environmental factors are, on an average, just as alike, or just as unlike, for monozygotic as for dizygotic twins" (Juel–Nielsen, 1965/1980, pp. 25–26).

> "In studies of twins, the higher intra-pair similarity for MZ as contrasted with DZ twins is frequently attributed to hereditary influence. This conclusion is based, in part, on the assumption that the environment is common to both types of twins" (Smith, 1965, p. 45).

> "The basic underlying assumption for the classical twin method is, of course, that environmental conditions of monozygotic twins do not differ from those of dizygotic twins" (Kringlen, 1967, p. 20).

Upon discovering that MZ and DZ environments are very different, some commentators were prepared to reject the twin method on this basis alone. For example, the psychologist Robert S. Woodworth concluded in his 1941 review, "Having convinced ourselves (in considering the 'twin method') that the environment differs more for fraternal than for identical twins, we cannot derive much information from a comparison of the results from the two classes of twins" (Woodworth, 1941, p. 21). And Neel and Schull, in their 1954 textbook *Human Heredity*, concluded that because it is "rarely . . . the case" that MZ and DZ environments are comparable, "twins have contributed little which may be extrapolated to other genetic situations" (p. 280).

In striking contrast to the earlier researchers, Smith and colleagues defined the equal environment assumption as follows:

> Importantly, the assumption is *not that MZs and DZs have equal environmental experiences*. It is well known, for example, that MZs are more likely to be dressed alike, share the same bedroom, and have the same friends . . . . Rather, the EEA assumes that these more similar environmental experiences do not lead to a greater co-twin similarity on the specific trait being studied. (2012, p. 19, emphasis in original)

Using the same Argument B "trait-relevant" definition used by other twin researchers since the 1960s, Smith and colleagues emphasized, paradoxically, that for them the equal environment assumption *does not* assume that the environments are equal. Thus, like others before them they redefined the equal environment assumption very differently from how it had been defined for the first 45 years of twin research, without any discussion of the historical or theoretical context in which they and their predecessors performed this redefinition. Many critics, in contrast, agree with the first two generations of twin researchers that the equal environment assumption assumes what it is supposed to assume — that without qualification, MZ and DZ twin pairs "have equal environmental experiences."

Smith et al. chose to focus on Suhay and colleagues' (2007) critique of twin research in political science (and by implication, other areas of social science). They addressed four major points put forward by Suhay and colleagues. *Point 1* states that MZ pairs have more similar experiences than DZ pairs; *Point 2* is that MZs experience a greater mutual influence than DZs; *Point 3* is that MZ pairs are treated more similarly than DZ pairs; *Point 4* is that MZ pairs share more similar prenatal (intrauterine) environments than DZ pairs. Let us now examine how Smith et al. responded to the four major points raised in Suhay and colleagues' (2007) critique.

Points # 1 and # 2: MZ Pairs Have More Similar Experiences, and Influence Each Other More, Than DZ pairs

Smith and colleagues saw Points 1 and 2 (similar experience and mutual influence) as being related to "similarities in the social environment and as such are consistent with traditional social science explanations for political attitudes and behaviors" (p. 29). In contrast, they saw Points 3 and 4 (similar treatment and prenatal environment) as "focus[ing] on biological environments" (p. 29). I will address this questionable latter claim in a subsequent section.

In their attempt to test some critics' argument that MZ–DZ behavioral trait correlation differences are caused by environmental factors, Smith and colleagues analyzed data obtained from 596 adult twin pairs (born between 1947 and 1956; 356 MZ, 240 DZ) based on the University of Minnesota Twin Registry. Afterwards, they decided to "replicate" their analysis on the basis of 30-year-old additional data they obtained from the Virginia 30K twin sample (p. 23). They argued that the data showed "little support" for the critics' contention that "exclusively environmental" factors explain MZ–DZ differences for traits such as political ideology (Smith et al., 2012, p. 17).

As an example of a political trait, Smith and colleagues chose "ideology" as assessed by the Wilson–Patterson Index. The Index purports to measure political conservatism, and consists simply of labels or catch-phrases of supposedly controversial issues (e.g., "socialism," "mixed marriage," "bible truth," "pyjama parties,"

"jazz," "women drivers," "learning Latin," "chaperones," and "striptease shows"; Wilson and Patterson, 1968, p. 266), to which respondents answer "yes," "no," or "?" (uncertain). The original Wilson–Patterson Index contained 50 such catch-phrases (Wilson and Patterson, 1968) and used this three-point response scale, but in the Minnesota sample the researchers used an updated and modified version containing 28 items and a seven-point response scale (the Virginia 30K sample used the three-point scale). The face validity of the Index is highly questionable (Charney, 2008a), and Smith and colleagues provided no evidence or citations in support of the validity of either the original or revised version.[9] Moreover, genetic researchers in political science tend to see "liberalism" and "conservatism" as the only political positions one can hold, when in fact the range is, historically and presently, much wider. The American researchers in particular appear to have committed the "fallacy of taking the local and particular for the universal" (Charney, 2008a, p. 309).

The researchers provided a table of MZ and DZ Minnesota Wilson–Patterson correlations (p. 22) as a product of varying levels of environmental similarity, as assessed by twins' answers to questions such as how often you "See your twin," "Talk to your twin on the telephone," "Communicate with twin via text/email," "Attended same classes at school," "Dressed alike when growing up," "Shared the same bedroom at home," and "Had the same friends growing up" (Smith et al., 2012, p. 22). Smith and colleagues recognized that "these items do not exhaust all potential categories of similar experience and mutual influence," but they saw them as being "comprehensive enough to provide a robust empirical test of the [critics'] key claims" (p. 21). As we will see, limiting the analysis to questions of this type fails to capture a major component of MZ twins' greater environmental similarity.

Smith and colleagues' table (p. 22) is noteworthy in that, for several environmental similarity categories, the authors arbitrarily combined differing responses into one score. To the question of whether twins were dressed alike when growing up, the only correlations listed in the table were the combined response categories "always/usually" and "sometimes/rarely/never." There is not a big distinction between "usually" and "sometimes." For the "Shared the same bedroom at home?"

---

[9]Even some psychometrically oriented researchers who support claims of important genetic influences on social attitudes had issues with the Wilson–Patterson Index. According to Minnesota twin researcher Thomas Bouchard and his colleagues, writing about the Wilson–Patterson Conservatism Scale, its "'catch phrase' format strikes many psychologists as inadequate and of doubtful validity. We concurred with this judgment, but because of the scale's brevity and the strong genetic influence on the Conservatism score derived from this instrument reported by Martin et al. (1986), we incorporated it into the MISTRA assessment" (Bouchard et al., 2004, p. 97). Thus, despite its "doubtful validity, " Bouchard and colleagues decided to use the Index in their twin study because of its "brevity," and because a previous group of twin researchers (Martin et al., 1986), based on their acceptance of the validity of both the Index and the equal environment assumption, concluded in favor of strong genetic influences on Conservatism.

question, the possible responses were "always," "usually," "sometimes," "rarely," and "never." However, the researchers decided to combine these five possible responses into only two categories: "always," and "usually/sometimes/rarely/never." Once again, there is not a great distinction between responses such as "usually" and "always." The reported and *non*-reported responses and correlations for two of the environmental similarity questions are seen in Table 2.

Perhaps a much different picture of the relationship between twin environmental similarity and Wilson–Patterson correlations would have emerged had

Table 2

Reported and Non-Reported Correlations Between Wilson–Patterson Index Ideology Scores and Environmental Similarity: Two Questions

	Combined Response Correlations (AS REPORTED)			
	MZ	N	DZ	N
"Shared the same bedroom at home?"				
Always	.67	262	.48	141
Usually/sometimes/rarely/never	.71	42	.17	41
"Had the same friends growing up?"				
Always/usually	.67	255	.46	101
Sometimes/rarely/never	.46	32	.17	72
	Non-Combined Response Correlations (NOT REPORTED)			
	MZ		DZ	
"Shared the same bedroom at home?"				
Usually	?		?	
Sometimes	?		?	
Rarely	?		?	
Never	?		?	
"Had the same friends growing up?"				
Always	?		?	
Usually	?		?	
Sometimes	?		?	
Rarely	?		?	
Never	?		?	

Reported correlations from Smith et al., 2012, p. 22. Correlations rounded to second decimal place; zero to the left of decimal point removed. MZ = reared-together monozygotic twin pairs; DZ = reared-together same-sex dizygotic twin pairs. N = number of twin pairs.

the researchers decided to show the correlations for each of the possible responses seen in Table 2 (see Kamin, 1981, for examples of how earlier twin researchers also combined responses). Additionally, in categories such as how often twins see each other ("See your twin?"), twins could choose from only two possible (potentially similar) answers, "Once a month or more," or "Several times a year or less." Smith and colleagues derived mean scores from twins' ordinal scale responses to the environmental similarity questions (p. 21), which constitutes a widespread yet questionable statistical practice because, with ordinal data, differences between responses are not equivalent, as they are with interval data (Bradley and Schaefer, 1998).

Although Smith et al. noted "relatively stable MZ correlations" (p. 22), in part because of the restricted and combined environmental similarity categories they used, they found "In contrast, DZ ideological similarities display extreme variation depending on levels of adult contact/similarity in childhood experiences" (p. 23). Nevertheless, Smith and colleagues continued to weakly uphold the validity of the twin method because, "overall, these results strongly suggest that MZ–DZ ideological similarities are not based solely in environmental similarities" (p. 23). This contrasts with their previously quoted definition of the equal environment assumption, where they wrote, "the EEA assumes that these more similar environmental experiences do not lead to a greater co-twin similarity on the specific trait being studied" (p. 19). Clearly, as the researchers themselves recognized, environmental similarity *does* lead to greater co-twin similarity for political traits.

Identity confusion and attachment. Some earlier critics of the twin method argued that the types of environmental similarity measures used by Smith et al. and others are limited, and while they assess some aspects of this similarity, they fail to adequately assess the nature of the attachment, conscious attempts to be alike, identity confusion, and ego fusion of MZ twin pairs. Family systems pioneer Don Jackson described "the intertwining of [MZ] twin identities, in the ego fusion that in one sense doubles the ego (because the other is felt as part of the self) and in another sense halves it (because the self is felt as part of the other)" [Jackson, 1960, p. 66]. According to the psychoanalytically oriented twin researcher Dorothy Burlingham, "Identical twins when they grow up often fail to develop into separate human entities" (quoted in Jackson, 1960, p. 66).

Looking at earlier twin studies whose authors attempted to assess twins' emotional closeness and attachment, Shields (1954) found that 47% of his MZ pairs experienced a "degree of attachment" that was "very close," whereas only 15% of the DZs experienced a very close degree of attachment (p. 234). Husén (1959) calculated an "index of attachment" for twins and found "a considerable mean difference" between MZ and DZ pairs (p. 143). Husén concluded that MZ pairs "are much more prone to emphasize the desire to be alike, to be together, to share the same interests, and to have a feeling of loyalty" (p. 142). Kringlen

(1967, p. 115) performed a "global evaluation of twin closeness" and found that 65% of MZ pairs had an "extremely strong level of closeness," which was true for only 17% of the DZ pairs. And in a 1966 twin study, Helen Koch found that "Identical [MZ] co-twins tended to be closer to each other than fraternals [DZs] . . ." (Koch, 1966, p. 132).

Some findings by earlier twin researchers that relate to twins' emotional attachment and identity issues are seen in Table 3. The results are taken from all twin

Table 3

Environmental Dissimilarity Among MZ and Same-Sex DZ Twin Pairs: Levels of Identity Confusion and Attachment

Study	Characteristic of Twin Relationship	MZ	DZ
von Bracken, 1934	"Closely attached"	87%	21%
Wilson, 1934	"Never separated from twin"	44%	27%
Mowrer, 1954	"Other twin as member of family that understands me best"	61%	24%
Mowrer, 1954	"Should be closer to my twin than other siblings"	70%	44%
Shields, 1954	"Very close degree of attachment"	47%	15%
Husén, 1959	"Very keen on always being together"	50%	25%
Cederlöf et al., 1961*	"As like [sic] as two peas"	54%	0%
Koch, 1966	"Sees likeness between himself and twin"	78%	54%
Nichols and Bilbro, 1966*	"Mistaken for each other by parents (as children)"	27%	0%
Kringlen, 1967	"Identity confusion in childhood"	90%	10%
Kringlen, 1967	"Mistaken for each other by parents and/or sibs"	21%	0%
Kringlen, 1967	"Considered alike as two drops of water"	76%	0%
Kringlen, 1967	"Inseparable as children to an extreme degree"	73%	19%
Kringlen, 1967	"Inseparable as adults to an extreme degree"	18%	0%
Kringlen, 1967	"Brought up 'as a unit'"	72%	19%
Kringlen, 1967	"Global evaluation of twin closeness"	65%	17%
Cohen et al., 1973*	"Confused for each other by mother of father"	78%	10%
Cohen et al., 1973*	"Sometimes confused by other people in family"	94%	15%
Cohen et al., 1973*	"Hard for strangers to tell them apart"	99%	16%
Cohen et al., 1975*	"Confused for each other by mother or father"	79%	1%
Cohen et al., 1975*	"Sometimes confused by other people in family"	93%	1%

studies I am aware of that provided percentage figures (or enough information to calculate percentages) based on twins' responses to questions relating to attachment and identity issues. I have excluded more common questions posed by modern twin researchers (including Smith et al., 2012), such as whether twins shared the same bedroom, attended school together, dressed alike, played together, etc. Some of the results in Table 3 were obtained by twin researchers using or developing questionnaires attempting to more easily and economically

Table 3 (Continued)

Study	Characteristic of Twin Relationship	MZ	DZ
Cohen et al., 1975*	"Hard for strangers to tell them apart"	99%	8%
Dalgard and Kringlen, 1976	"Extreme or strong interdependence in childhood"	86%	36%
Dalgard and Kringlen, 1976	"Brought up as a unit"	92%	75%
Dalgard and Kringlen, 1976	"Extreme or strong closeness in childhood"	86%	36%
Kasriel and Eaves, 1976*	"Confused for each other in childhood"	98%	6%
Torgersen, 1979*	"As alike as two peas in a pod"	83%	1%
Torgersen, 1979*	"Twins mixed up for each other as children"	71%	2%
Morris–Yates et al., 1990	"Parental treatment of twins as two individuals"	55%	83%

Sources (same-sex twin pair samples sizes; country): Cederlöf et al., 1961, p. 344 (MZ = 81, DZ = 100; Sweden); Cohen et al., 1973, p. 467 (MZ = 94, DZ = 61; United States); Cohen et al., 1975, p. 1374 (MZ = 181, DZ = 84; United States); Dalgard and Kringlen, 1976, p. 224 (MZ = 49, DZ = 89; Norway); Husén, 1959, p. 141 (MZ = 26, DZ = 24; Sweden); Kasriel and Eaves, 1976, p. 265 (MZ = 94, DZ = 84; United Kingdom); Koch, 1966, p. 233 (MZ = 70, DZ = 72; United States); Kringlen, 1967, p. 115 (MZ = 75, DZ = 42; Norway); Morris–Yates et al., 1990, p. 323 (MZ = 186, DZ = 157; Australia); Mowrer, 1954, pp. 469–470 (based on "612 twins," status not stated; United States); Nichols and Bilbro, 1966, p. 270 (MZ = 82, DZ = 41; United States); Shields, 1954, p. 234 (MZ = 36, DZ = 26; United Kingdom); Torgersen, 1979, p. 228 (MZ = 98, DZ = 117; Norway); von Bracken, 1934, p. 299 (MZ = 23, DZ = 19; Germany); Wilson, 1934, p. 334 (MZ = 70, DZ = 55; United States).

MZ = monozygotic twin pairs; DZ = same-sex dizygotic twin pairs. Includes studies whose authors provided percentage figures for environmental similarity, or enough information to calculate percentages. Excluded are studies whose authors provided only correlations or mean scores, or correlations between twins' environmental similarity and the trait under study. Excludes questions such as whether twins shared the same bedroom, attended school together, dressed alike, played together, etc. The Cohen et al. 1973 and 1975 studies were based on different twin samples.

*Studies obtaining information in the context of using or developing questionnaires designed to distinguish between MZ and DZ pairs.

distinguish MZ from DZ pairs for future twin studies.[10] Although there are various methodological issues in these studies, the trend is clear that MZ twin pairs experience much greater levels of identity confusion and attachment than DZ pairs, which we would expect to contribute to their greater resemblance for behavioral (including political) traits.

The findings in Table 3, which plausibly explain at least a portion of MZ–DZ behavioral correlation differences, are rarely cited by contemporary twin researchers and their supporters. They were not mentioned or directly assessed in Smith and colleagues' (2012) study, nor in any other publication by genetic researchers in political science that I am aware of. Of the researchers using or developing questionnaires, only the Cohen group commented on the irony of needing to demonstrate the great dissimilarity of MZ and DZ childhood environments as a method to reliably distinguish between MZ and DZ twin pairs. As we have seen, the twin method assumes that these environments are *not* dissimilar. According to the researchers, "The impact of such repeated confusion on individual twinships, or the effect of these differences between MZ and DZ twins is not known with certainty. However, such information must cast doubt upon the assumption of environmental equivalence" (Dibble, Cohen, and Grawe, 1978, pp. 246–248). In other words, in the process of developing a questionnaire designed to help future twin researchers reliably distinguish between MZ and DZ pairs, the researchers noticed that their data, which showed greatly unequal MZ–DZ childhood environments, cast doubt on the validity of the twin method itself.

Attempting to uphold the validity of twin research in political science, Medland and Hatemi (2009) wrote, "it is difficult to conceive of a population where parents of MZ twins would purposely or unconsciously socialize their children [more than DZ twins] to support the same political party" (p. 199). However, it is *not* difficult to conceive of a population in which MZs' greater attempts to be like each other, in addition to their much greater levels of closeness, loyalty, attachment, and identity confusion (as seen in Table 3), would cause them to hold similar political views, and support the same candidates and parties, much more often than DZ pairs.

From Argument B . . . to Argument A. In direct contrast to the way the equal environment assumption was defined in its first five decades of existence, we have seen that Smith and colleagues initially defined the assumption in its Argument B form, meaning that environments need only be equal as they influence the development of the trait in question. They upheld the validity of the assumption by concluding that the acknowledged greater environmental

[10]In twin research, the procedure used to distinguish MZ and DZ pairs is known as "zygosity determination."

similarity of MZ versus DZ pairs does not have a major trait-relevant impact on the former's greater resemblance for political ideology.

However, aside from the questionable methods they used to reach this conclusion, the Argument B defense of the equal environment assumption must generalize, in the behavioral and political trait context, to the untenable position that the social environment has little influence on *anyone's* behavior — whether twins or single-born individuals. If researchers conclude that the social environment does not have much influence on individual MZ twin's political ideology, they should conclude that this holds true for non-twins as well. For Smith and colleagues' Argument B conclusion in support of the equal environment assumption to hold, therefore, they should also conclude that environmental factors have little influence on political ideology and human behavior in general, and that social environments for all human beings (at least in the political context) are largely trait-*ir*relevant (Joseph, 2006).

We have seen that the Argument A "twins create their own environment" position is based on a circular argument whereby the statement that the greater behavioral resemblance of MZ versus DZ pairs is caused by genetic factors is both a conclusion *and a premise* of the twin method (see Figure 1). Nevertheless, Smith and colleagues employed this argument in their analysis, writing that "it is . . . possible that ideological similarity leads to environmental similarity" (p. 28):

> In other words, if liberals prefer the company of liberals over conservatives, and vice versa, twins who are more alike ideologically may be more likely to maintain a high level of contact with their co-twin. If, *as twin studies suggest*, there is a genetic predisposition toward ideology, this in turn raises the possibility that there is a genetic component underlying the environmental variation reported by twins. This latter view already has considerable empirical support. (Smith et al., 2012, p. 28, emphasis added)

This passage captures over 50 years of twin researchers' Argument A defense of the twin method in the social and behavioral sciences. Smith and colleagues argued that "there is a genetic component underlying the environmental variation reported by twins," which they supported with the circular claim that "twin studies suggest" that this is the case. The purpose of their study was to test some critics' argument that environmental factors completely explain MZ–DZ behavior correlation differences, but in the process they *assumed* the validity of genetic interpretations of previous twin studies in order to currently *conclude* in favor of such interpretations.

Reasoning of this type led Smith and colleagues to claim, mistakenly, that the correlation between DZ pairs' trait-relevant environmental similarity and their resemblance for political ideology is a *genetic* effect: "Environmental similarities seem to influence similarities in political temperament, but this influence is mediated by genes" (Smith et al., 2012, p. 23). Thus, like the post-traumatic stress disorder twin researchers we visited earlier, Smith and colleagues ultimately

concluded in favor of genetics and the validity of the twin method more on the basis of Argument A than on Argument B. Using the same faulty reasoning that we saw explicitly laid out by Derks et al. (2006), Smith and colleagues, after recognizing that their Argument B equal environment assumption definition was not supported by some aspects of their (albeit flawed and limited) data, chose to uphold the validity of the assumption by invoking the Argument A position that the trait-relevant environmental influences that "seem to influence similarities in political temperament" are negated, because the influences of these "environmental similarities" are "mediated by genes." The circularity of this argument is seen in Figure 2.

The researchers' defense of the twin method, at least as they attempted to explain their DZ results, ultimately rested on the Argument A conclusion *and premise* that "as twin studies suggest, there is a genetic predisposition toward ideology." Their error in reasoning, seen in Figure 2, is that when assessing the meaning of twin method data, one cannot simultaneously assume and conclude that "there is a genetic predisposition toward ideology." In using such faulty reasoning, the researchers committed the fallacy of calling on an unproven premise and an unproven conclusion to cross-validate each other.

Conclusion. We have seen that both the data and the arguments Smith and colleagues (2012) presented in support of the equal environment assumption do little to counter Points 1 and 2 as summarized by Suhay and colleagues (2007). Thus, as many critics have argued, it is likely that the more similar experiences and greater mutual influence of MZ compared with DZ twin pairs, in addition to their greater levels of identity confusion and attachment, play a major role in explaining the greater political and behavioral trait resemblance of MZ versus DZ pairs.

The quoted statement is both a premise and a conclusion of the study. The conclusion supports the premise; the premise supports the conclusion, and so on.

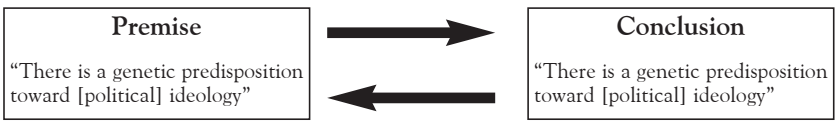


Figure 2: Circular reasoning used in Smith and colleagues' defense of the equal environment assumption in political science twin studies. Quotations from Smith et al., 2012, p. 28. Figure modified from Jay Joseph (2012), "The 'Missing Heritability' of Psychiatric Disorders: Elusive Genes or Non-Existent Genes?" *Applied Developmental Science, 16*(2), p. 71. © 2012 Taylor & Francis Group, New York.

Point #3: Is More Similar Treatment (Based on Similar Appearance) a Genetic Effect?

Smith and colleagues went on to address the critics' argument that MZ pairs are treated more alike than DZ pairs in many respects. We have seen that most twin researchers have recognized for decades that MZ pairs are treated more alike than are DZ pairs, and we saw in Table 3 that MZ pairs experience much greater levels of identity confusion and attachment than DZ pairs. As Husén concluded, "it is mainly the desire to be dissimilar and to compete with each other, etc., that differentiates the DZ-pairs from the MZ-pairs" (Husén, 1959, p. 145). Since the 1960s, we have seen that twin researchers have responded to the "overwhelming" evidence that MZs receive more similar treatment than DZs mainly by arguing, in direct contrast to how they interpret family study data, (a) that MZ pairs create more similar environments for themselves because they are more similar genetically, and/or (b) that it must be shown that MZ twin pairs experience more similar trait-relevant environments than those experienced by DZ pairs (see Table 1).

Although social beliefs in western countries dictate that MZ pairs should be treated more alike than DZs (Rosenthal, 1970), and although most twin researchers in political science recognize that MZs are treated more alike than DZs in many respects by parents and others (e.g., Hatemi et al., 2010; Medland and Hatemi, 2009), Smith and colleagues chose to focus only on the more similar treatment elicited by MZs' more similar *physical appearance*, conceding that "there is some basis for such an expectation" (p. 29). However, they mistakenly counted this as a *genetic* effect, arguing that "whatever variation in ideological similarity [that] can be attributed to physical appearance has an indisputably genetic basis. Even critics of twin studies concede that MZ twin pairs look more alike than DZ pairs because of their close genetic relationship" (p. 29). This position, in fact, is very disputable. The claim that treatment similarity based on physical appearance counts as a genetic effect must be therefore examined more closely.

Charney (2008b) has pointed to the "fallacious nature" of counting treatment effects based on appearance as genetic effects. He noted that people with the inherited trait of black skin color were forced into slavery, and asked, "Are we to assume then, that the effects upon blacks of their enslavement by European whites were *genetic*, because slavery was 'caused' or 'elicited' or 'created' by the genetic trait of black skin color?" (Charney, 2008b, p. 337, emphasis in original). Based on the logic of Smith and colleagues' position, the status of being a slave should be seen as an "indisputably" strongly genetic trait, because virtually all variation in the population of the Confederacy for the status of being a "slave" or a "non-slave" was attributed to the inherited trait of dark skin color.

Another example is Neurofibromatosis Type I, a true genetic disorder caused by a malfunctioning gene on chromosome 17, that can cause severe facial dis-

figurement. It is possible, even likely, that an unfortunate pair of monozygotic twins with this condition would both suffer from depression and severe social anxiety. Still, it would be very mistaken to view their depression and anxiety as being caused by genetic factors simply because Neurofibromatosis Type I is a genetic disorder. In fact, the etiology of Neurofibromatosis Type I in this example has no bearing on whether we view the twins' depression and anxiety as being caused by genetic factors, since their conditions are clearly caused by years of mistreatment and negative reactions they received, both as children and as adults, from people in their schools and neighborhoods, in shopping centers and movie theaters, and so on. The emotional disorders of these twins are not caused by any genes for depression or anxiety, but rather by the treatment they receive from other people throughout their lives.

A further point is Smith and colleagues' (2012) claim that "pharmacological manipulation of social interactions consistently suggest that biology plays a crucial role in shaping social, economic, and political attitudes and behavior." They saw this as supporting the position that "biological systems built by genes seem to play an important role in mediating political attitudes" (p. 18). They could make such a claim only in the context of one of the themes of their article, which is the invalid conflation of biological causation and genetic causation. The possible influence of a prescribed medication, or even a martini or a narcotic, on how people behave in social situations does nothing to support the genetic argument, other than point out the undeniable fact that the ingestion of certain chemicals can influence people's behavior.

Smith and colleagues wondered "whether physical appearance systematically creates an environment that socializes individuals into a particular set of political attitudes" (p. 29). They were right to question this, but to the extent that it might be occurring, they mistakenly counted this as a genetic effect.

Point # 4: Do Prenatal (Intrauterine) Environmental Differences Count as Genetic?

Continuing the theme of counting that what are in fact environmental influences on twin pair resemblance as genetic influences, and of conflating potential biological and genetic influences on traits and disorders, Smith et al. addressed Suhay and colleagues' (2007) argument that MZ twins' more similar prenatal (intrauterine) environment might further confound MZ–DZ political trait comparisons. One reason that most critics of the twin method have steered clear of this argument is that it implies endorsement of the idea that non-genetic biological brain malfunctions contribute to variation in abnormal behavior and psychiatric disorders (critics of genetic theories in political science who avoided the intrauterine environment include Beckwith and Morris, 2008; Charney 2008a, 2008b; Joseph, 2010b). Nevertheless, Smith and colleagues seized on

the Suhay et al. argument and claimed that the latter's comments on the more similar intrauterine environment of MZ pairs "brings critics of twin studies into agreement with proponents on a key issue, namely the importance of biological precursors of adult ideology that are present at birth" (p. 30). In addition to mistakenly implying (here and elsewhere in their study) that Suhay and colleagues' (2007) analysis represents the views of all "critics" of twin research, this is a fundamentally flawed position.

Biological and genetic influences are not the same thing, and in many cases biological causes are *environmental* causes. Although it is true that every genetic influence must have a corresponding biological substrate, the reverse is not true: many biological influences are not genetic or inherited. As Gottesman and Hanson (2005) pointed out, "Everything that is genetic is biological, but not all things biological are genetic" (p. 265). The measles virus is one of countless such examples. Death caused by rattlesnake venom is another. The authors of a hypothetical twin study of death by rattlesnake venom, who find much higher MZ vs. DZ concordance (because MZ pairs spend more time together than DZ pairs and have more similar interests), could not conclude in favor of an important genetic influence on death resulting from a rattlesnake bite.

Another example would be a twin study of birth defects. In such a study, all twin pairs would be born to mothers who had been prescribed the drug Thalidomide in the 1950s and 1960s, which was subsequently shown to cause birth defects in children born to these mothers. As Smith and colleagues recognized (p. 29), in the intrauterine setting, MZ pairs share a more similar placental and chorionic environment than experienced by DZs (Bulmer,1970). This means that MZ pairs would be more similarly exposed to Thalidomide and other potential toxins prenatally than would DZ pairs.

Suppose a group of twin researchers finds that the MZ correlation for Thalidomide-related birth defects is 60%, but only 15% for the DZ pairs. This finding would be the result of a biological agent (Thalidomide) affecting MZs more than DZs, since the former share a more similar intrauterine environment. The differing correlations would be explained by biological factors, but *not* by genetic factors. Thus, any conclusion in favor of genetics and a 90% heritability estimate for birth defects would clearly be mistaken (though welcomed and cited by the manufacturers of Thalidomide), since higher MZ concordance would be the result of non-genetic biological factors. Based on Smith and colleagues' faulty reasoning that such factors count as genetic factors, they would likely conclude in favor of an important role for genetic influences on birth defects because the study demonstrated the importance of "biological precursors" of birth defects "that are present at birth."

Let us further imagine a study of pregnant mothers of twins who had ingested an imaginary drug called "Politomide," a chemical agent that impacted the brains of twin fetuses in a way that subsequently caused adult MZ pairs to resemble

each other more for political ideology than adult DZ pairs. According to Smith and colleagues' logic, a finding that intrauterine "Politomide" exposure influenced adult political ideology would lend support to the idea that the twin method is a valid instrument for the detection of *genetic* influences. In this example, however, a non-inherited biological influence contributes to MZ–DZ differences in political ideology, and any conclusions in support of genetic influences on political ideology would be mistaken.

So even in the unlikely event that biological agents shared to a greater degree by MZ versus DZ pairs in the intrauterine environment contribute to the former's greater resemblance for political ideology as adults, this would do nothing to support the theoretical basis of the twin method. On the contrary — this finding would constitute yet another environmental influence confounding genetic interpretations of twin method data.

The Twin Method Versus the Real World: Which Provides the Better "Natural Experiment"?

Behavioral genetic researchers and political scientists using behavioral genetic methods frequently refer to the twin method as a "naturally occurring experiment centered on twins" (Smith et al., 2012, p. 18), and as an "experiment of nature" (Plomin et al., 2008, p. 38). At the same time, they frequently overlook, downplay, or ignore research from outside their field demonstrating the importance of environmental factors. As the child psychiatrist Michael Rutter observed, "It is quite striking that behavioral genetics reviews usually totally ignore the findings on environmental influences. It is almost as if research by non-geneticists is irrelevant" (2006, pp. 11–12). They also tend to overlook numerous real world "natural experiments" that argue against their major theories.

The evolutionary biologist Richard Lewontin observed in 1987 that both genetically oriented researchers, and their environmentalist critics, wish "to determine how much change is possible so that we may act rationally in social programs." Lewontin then wondered why behavioral genetic researchers "keep studying heritability, which simple logic tells us cannot give the answer to this problem." As to why these researchers usually do not "ask the questions about changeability directly," he believed that it is "because the answer would come out in the wrong direction" (Lewontin, 1987, p. 32). Behavioral genetic methods assess environmental factors indirectly in the process of performing studies attempting to assess the role of genetic factors. The "shared" and "non-shared" environmental components they calculate are simply the remaining portions of the population variance after heritability estimates are calculated. Real world examples and studies directly assessing the importance of the environment, which from the genetic perspective frequently "come out of the wrong direction," are as Rutter pointed out often ignored by behavioral genetic researchers.

Smith and colleagues (2012) wrote, "In many respects" the findings from political science twin studies "contradict decades of empirical work in political science treating individual differences in attitudes as environmentally determined and the environmental experiences shared by family members as particularly effective agents of political socialization" (pp. 17–18). Even if we frame the issue only on the basis of research attempting to assess genetic or socialization influences on individual differences in political traits, the question nonetheless comes down to "decades of empirical work" showing the importance of environmental influences, versus decades of (as I have attempted to show) *unsuccessful* attempts to validate the equal environment assumption of the twin method.

Like others before them, Smith and colleagues (2012) failed to recognize and consider the larger historical, social, and political experiences that argue against their thesis. As one of many possible examples, for non-genetic reasons we would expect a Wilson–Patterson type "government provided health care" item to show marked differences between people of British ancestry living on either side of the United States–Canada border. As another example, Germany was heavily anti-Nazi in the late 1920s, and heavily pro-Nazi just a few years later. Conversely, researchers could have administered the Wilson–Patterson "socialism" question to Germans on either side of the Berlin Wall in 1965, and no one would have expected similar scores on both sides of the Wall. Similarly, we could have posed the Wilson–Patterson "apartheid" question to Blacks and Whites in South Africa in 1980, and currently pose the "bible truth" question to Coptic Christians and Muslims in Egypt, and we should expect to see very different patterns of answers in each set of two populations.

The same point can be made currently in relation to the genetically homogeneous populations of "socialist" North Korea ("Democratic People's Republic of Korea") and "capitalist" South Korea ("Republic of Korea"). If a research team finds that Koreans on both sides of the demilitarized zone that divides the two countries give similar levels of "yes" or "no" responses (confidentially) to the Wilson–Patterson "socialism" question, this finding would lend far more support to genetic theories in political science than any inferences one could draw on the basis of Minnesota and Virginia twin register data. However, the expected large score difference between responses in the North and South would provide additional evidence against such theories.[11]

Smith and colleagues (2012) believed that "the validity of challenges to twin studies should be addressed as empirical issues rather than debating points" (p. 30). Examples such as these, however, are empirical "natural experiments" suggesting that non-genetic factors strongly influence political attitudes and behavior, regard-

[11]Despite the influences of family and political socialization, education, and propaganda, Wilson–Patterson "socialism" scores in North Korea and South Korea could be affected by disillusionment with the economic and political realities in both countries. Naturally, this would still be related to environmental as opposed to genetic influences.

less of correlations researchers derive from narrow ahistorical analyses of (environmentally confounded) twin data. These analyses, which include four decades of "equal environment assumption test" studies (see Joseph, 2006; Medland and Hatemi, 2009), not only fail to address the social, historical, and political events that argue against their authors' conclusions, but also fail to adequately address the historical findings, controversies, biases, definition changes, and political aspects of twin research itself (Joseph, 2004; Joseph and Wetzel, 2013; Kamin, 1974; Lewontin et al., 1984; Teo and Ball, 2009).

The empirical evidence from the history of political movements and political change, indeed from all human history, argues strongly against current "genopolitical" theories based on twin research. According to Charney (2008a), the acceptance of genetic theories in political science "would require nothing less than a revision of our understanding of all of human history, much — if not most — of political science, sociology, anthropology, and psychology, as well as, perhaps, our understanding of what it means to be human" (p. 300). At the same time, we have seen that empirical data from twin research *fails* to provide scientifically acceptable evidence in support of a genetic basis for political traits. Far more can be learned from history textbooks about the genetic basis of political attitudes and behavior — or the lack of such a basis — than from any behavioral genetic study one could mention.

Summary and Conclusions

Recent attempts by twin researchers in political science to uphold the validity of the twin method and its all-important "equal environment assumption" do not hold up to critical examination. From the outset of their publication, Smith and colleagues framed the issue in a way that guaranteed validation of the twin method. Additional errors arguing against Smith and colleagues' conclusions include that they:

1. Put forward the untenable Arguments A and B in support of the equal environment assumption in the face of overwhelming evidence that MZ and same-sex DZ environments are not equal.
2. Used inadequate methods to assess twin environmental similarity and political ideology.
3. Reached several conclusions that argue against the validity of the equal environment assumption.
4. Mistakenly counted environmental effects on twins' behavioral resemblance as genetic effects.
5. Did not account for levels of identity confusion and attachment experienced to a much greater degree by MZ than DZ twin pairs.

6. Mistakenly conflated the potential, yet differing, roles of biological and genetic effects on twin resemblance.
7. Overlooked or downplayed current and historical political events, situations, and research that argue against their thesis.

Earlier, I pointed to the ongoing failure of molecular genetic researchers to discover genes underlying political behaviors and traits, with all results thus far either negative or unreplicated (Benjamin et al., 2012; Charney and English, 2012; Hatemi and McDermott, 2012). Similar negative gene finding results have occurred for psychological traits such as I.Q. and personality (Chabris et al., 2012; Deary, 2012; Plomin, 2013), psychiatric disorders such as schizophrenia (Collins et al., 2012), and other observed variation in human behavior (Wahlsten, 2012). Molecular genetic researchers continue to cite the results of twin research to justify the continuation of their work, but a more plausible explanation for the negative results obtained thus far is that 90 years of misinterpreting twin method results in favor of genetics has led to decades of fruitless gene searches in psychiatry, psychology, and the social sciences (Joseph, in press; Joseph and Ratner, 2013; Latham and Wilson, 2010).

Smith and colleagues thus join a long list of twin researchers who, based on their acceptance of the equal environmental assumption fallacy, mistakenly concluded in favor of important genetic influences on traits and behaviors intuitively understood as being caused by non-genetic factors. These twin studies include those looking at breakfast eating patterns (Keski–Rahkonen, Viken, Kaprio, Rissanen and Rose, 2004), cell phone use (Miller, Zhu, Wright, Hansell, and Martin, 2012), ethnocentrism (Orey and Park, 2012), finger-sucking and nail-biting in childhood (Ooki, 2005), female sexual dysfuntion (Burri, Greven, Leupin, Spector, and Rahman, 2012), frequency of orgasm in women (Dawood, Kirk, Bailey, Andrews, and Martin, 2005), happiness (Bartels and Boomsma, 2009), loneliness (Boomsma, Willemsen, Dolan, Hawkley, and Cacioppo, 2005), physical activity in young adults (Mustelin et al., 2012), problematic masturbatory behavior in children (Långström, Grann, and Lichtenstein, 2002), sedentary behavior during adolescence (van der Aa et al., 2012), tea and coffee drinking preferences (Luciano, Kirk, Heath, and Martin, 2005), and voter turnout (Loewen and Dawes, 2012). In addition to the unsupported claim that twin research has shown these behaviors and traits to have an important genetic basis, research of this type encourages reductionistic focus on biological and genetic factors — and away from social and environmental factors — as the main way society should think about and approach human behavioral differences (Lewontin, 1991; Rose, 1997).

The two main competing hypotheses for explaining the usual finding that MZs correlate higher than same-sex DZs for behavioral traits are: (1) based on

the *acceptance* of the equal environment assumption, important genetic influences underlie variation in most human behavioral traits; or (2) based on the *rejection* of the equal environment assumption, MZ–DZ correlation differences are caused exclusively by non-genetic influences. On the basis of the more plausible "Hypothesis 2" position, previously reported twin method MZ–DZ comparisons point to nothing more than the importance of *non-*genetic influences on human behavioral trait variation.

Medland and Hatemi wrote in 2009 that "there is no evidence" that the more similar environments experienced by MZ twin pairs are "influencing MZ co twin correlations for political preferences" (p. 199). Three years later, Smith et al. (2012) reached a similar conclusion. However, viewing twin data from the Hypothesis 2 perspective suggests that this "evidence" is *precisely what the finding of greater MZ versus DZ resemblance for political traits has uncovered*.

Critics have argued for decades that the twin method is unable to disentangle the potential roles of genetic and environmental influences, and genetic researchers in political science have been no more able than their predecessors in psychology and psychiatry to provide convincing arguments otherwise. Acceptance of the Hypothesis 2 position that the twin method is unable to disentangle genetic and environmental influences does not mean that twin studies "overestimate heritability," or that the equal environment assumption should be tested "trait-by-trait," but rather indicates that the twin method should be evaluated in exactly the same way as most behavioral geneticists currently evaluate family studies (seen in Table 1). This means that *genetic interpretations of twin method data in political science, psychology, psychiatry, and other social and behavioral sciences must be rejected outright*. Thus, twin studies have provided no reason to re-evaluate previous theories stressing the dominant behavior-shaping influences of factors such as family, culture, the media, birth cohort effects, social policy decisions, religion, oppression, learned gender and class roles, and education.

References

Ainslie, R.C. (1997). *The psychology of twinship*. Northvale, New Jersey: Jason Aronson.

Alford, J.R., Funk, C.L., and Hibbing, J.R. (2005). Are political orientations genetically transmitted? *American Political Science Review, 99,* 153–167.

Alford, J.R., Funk, C.L., and Hibbing, J.R. (2008). Beyond liberals and conservatives to political genotypes and phenotypes. *Perspectives on Politics, 6,* 321–328.

Barondes, S.H. (1998). *Mood genes: Hunting for origins of mania and depression*. New York: Oxford University Press.

Bartels, M., and Boomsma, D.I. (2009). Born to be happy? The etiology of subjective well-being. *Behavior Genetics, 39,* 605–615.

Beckwith, J., and Morris, C.A. (2008). Twin studies of political behavior: Untenable assumptions? *Perspectives on Politics, 6,* 785–791.

Benjamin, D.J., Cesarini, D., van der Loos, M.J.H.M., Dawes, C.T., Koellinger, P.D., Magnusson, P.K.E., et al. (2012). The genetic architecture of economic and political preferences. *PNAS, 109,* 8026–8031.

Bleuler, M. (1978). *The schizophrenic disorders: Long-term patient and family disorders*. New Haven, Connecticut: Yale University Press.
Boomsma, D.I., Willemsen, G., Dolan, C.V., Hawkley, L.C., and Cacioppo, J.T. (2005). Genetic and environmental contributions to loneliness in adults: The Netherlands Twin Register Study. *Behavior Genetics, 35,* 745–752.
Bouchard, T.J., Jr. (1993). Genetic and environmental influences on adult personality: Evaluating the evidence. In J. Hettema and I. Deary (Eds.), *Basic issues in personality* (pp. 15–44). Dordrecht, The Netherlands: Kluwer Academic Publishers.
Bouchard, T.J., Jr., and McGue, M. (2003). Genetic and environmental influences on human psychological differences. *Journal of Neurobiology, 54,* 4–45.
Bouchard, T.J., Jr., Segal, N.L., Tellegen, A., McGue, M., Keyes, M., and Krueger, R. (2004). Genetic influence on social attitudes: Another challenge to psychology from behavior genetics. In L. DiLalla (Ed.), *Behavior genetics principles* (pp. 89–104). Washington, DC: American Psychological Association Press.
Bradley, W.J., and Schaefer, K.C. (1998). *The uses and misuses of data and models.* Thousand Oaks, California: Sage.
Buchan, L. (2012). The anatomy of politics. *Nature, 490,* 466–468.
Bulmer, M.G. (1970). *The biology of twinning in man.* Oxford: Clarendon Press.
Burri, A., Greven, C., Leupin, M., Spector, T., and Rahman, Q. (2012). A multivariate twin study of female sexual dysfunction. *Journal of Sexual Medicine, 9,* 2671–2681.
Carey, G., and DiLalla, D.L. (1994). Personality and psychopathology: Genetic perspectives. *Journal of Abnormal Psychology, 103,* 32–43.
Carter, H.D. (1940). Ten years of research on twins: Contributions to the nature–nurture problem. In G. Whipple (Ed.), *National society for the study of education yearbook* (pp. 235–255; Volume 39, Number 1). Bloomington, Illinois: Public School Publishing.
Cederlöf, R., Friberg, L., Jonsson, E., and Kaij, L. (1961). The diagnosis of twin zygosity. *Acta Genetica et Statistica Medica, 11,* 338–362.
Cesarini, D., Johannesson, M., Wallace, B., and Lichtenstein, P. (2009). Heritability of overconfidence. *Journal of the European Economic Association, 7,* 617–627.
Chabris, C.F., Hebert, B.M., Benjamin, D.J., Beauchamp, J.P., Cesarini, D., van der Loos, M., Johannesson, M., Magnusson, P.K.E., Lichtenstein, P., Atwood, C.S., Freese, J., Hauser, T.S., Hauser, R.M., Christakis, N.A., and Laibson, D. (2012). Most reported genetic associations with general intelligence are probably false positives. *Psychological Science, 23,* 1314–1323.
Charney, E. (2008a). Genes and ideologies. *Perspectives on Politics, 6,* 292–319.
Charney, E. (2008b). Politics, genetics, and "greedy reductionism." *Perspectives on Politics, 6,* 337–343.
Charney, E. (2012). Behavior genetics and post genomics. *Behavioral and Brain Sciences, 35*, 331–358.
Charney, E., and English, W. (2012). Candidate genes and political behavior. *American Political Science Review, 106,* 1–34.
Cohen, D.J., Dibble, E., Grawe, J.M., and Pollin, W. (1973). Separating identical from fraternal twins. *Archives of General Psychiatry, 29,* 465–469.
Cohen, D.J., Dibble, E., Grawe, J.M., and Pollin, W. (1975). Reliably separating identical from fraternal twins. *Archives of General Psychiatry, 32,* 1371–1375.
Collins, A.L., Kim, Y., Sklar, P.; International Schizophrenia Consortium, O'Donovan, M. C., and Sullivan, P.F. (2012). Hypothesis-driven candidate genes for schizophrenia compared to genome-wide association results. *Psychological Medicine, 42,* 607–616.
Dalgard, O.S., and Kringlen, E. (1976). A Norwegian twin study of criminality. *British Journal of Criminology, 16,* 213–232.
Dawood, K., Kirk, K.M., Bailey, J.M., Andrews, P.W., and Martin, N.G. (2005). Genetic and environmental influences on the frequency of orgasm in women. *Twin Research and Human Genetics, 8,* 27–33.
Deary, I.J. (2012). Intelligence. *Annual Review of Psychology, 63,* 453–482.
DeFries, J.C., and Plomin, R. (1978). Behavioral genetics. *Annual Review of Psychology, 29,* 473–515.
Derks, E.M., Dolan, C.V., and Boomsma, D.I. (2006). A test of the equal environment assumption (EEA) in multivariate twin studies. *Twin Research and Human Genetics, 9,* 403–411.

Dibble, E., Cohen, D.J., and Grawe, J.M. (1978). Methodological issues in twin research: The assumption of environmental equivalence. In W. Nance (Ed.), *Twin research: Psychology and methodology* (pp. 245–251). New York: Alan R. Liss.

Eysenck, H.J., and Prell, D.B. (1951). The inheritance of neuroticism: An experimental study. *Journal of Mental Science, 97,* 441–465.

Faraone, S.V., and Biederman, J. (2000). Nature, nurture, and attention deficit hyperactivity disorder. *Developmental Review, 20,* 568–581.

Felson, J. (2009). *What can we learn from twin studies? A comprehensive evaluation of the equal environment assumption* (Doctoral dissertation, Pennsylvania State University). Retrieved from https://etda.libraries.psu.edu/paper/10104/4970

Flint, J., Greenspan, R.J., and Kendler, K.S. (2010). *How genes influence behavior*. Oxford: Oxford University Press.

Fowler, J.H., and Dawes, C.T. (2009). Partisanship, voting, and the dopamine D2 receptor gene. *Journal of Politics, 71,* 1157–1171.

Gottesman, I.I. (1963). Heritability of personality: A demonstration. *Psychological Monographs, 77,* (9, whole volume 572), 1–21.

Gottesman, I.I., and Hanson, D.R. (2005). Human development: Biological and genetic processes. *Annual Review of Psychology, 56,* 263–286.

Gottesman, I.I., and Shields, J. (1966). Contributions of twin studies to perspectives on schizophrenia. In B. Maher (Ed.), *Progress in experimental personality research* (Vol. 3, pp. 1–84). New York: Academic Press.

Hatemi, P.K., Gillespie, N.A., Eaves, L.J., Maher, B.S., Webb, B.T., Heath, A.C., et al. (2011). A genome-wide analysis of liberal and conservative political attitudes. *Journal of Politics, 73*, 1–15.

Hatemi, P.K., Hibbing, J.R., Medland, S.E., Keller, M.C., Alford, J.R., Smith, K.B., Martin, N.G., and Eaves, L.J. (2010). Not by twins alone: Using the extended family design to investigate genetic influence on political beliefs. *American Journal of Political Science, 54,* 798–814.

Hatemi, P.K., and McDermott, R. (2012). The genetics of politics: Discovery, challenges, and progress. *Trends in Genetics, 28,* 525–533.

Holzinger, K.J. (1929). The relative effect of nature and nurture influences on twin differences. *Journal of Educational Psychology, 20,* 241–248.

Husén, T. (1959). *Psychological twin research: A methodological study*. Stockholm: Almqvist and Wiksell.

Jackson, D.D. (1960). A critique of the literature on the genetics of schizophrenia. In D. Jackson (Ed.), *The etiology of schizophrenia* (pp. 37–87). New York: Basic Books.

Jones, H.E. (1955). Perceived differences among twins. *Eugenics Quarterly, 2,* 98–102.

Joseph, J. (1998). The equal environment assumption of the classical twin method: A critical analysis. *Journal of Mind and Behavior, 19,* 325–358.

Joseph, J. (2004). *The gene illusion: Genetic research in psychiatry and psychology under the microscope*. New York: Algora. (2003 United Kingdom Edition by PCCS Books)

Joseph, J. (2006). *The missing gene: Psychiatry, heredity, and the fruitless search for genes*. New York: Algora.

Joseph, J. (2010a). Genetic research in psychiatry and psychology: A critical overview. In K. Hood, C. Tucker Halpern, G. Greenberg, and R. Lerner (Eds.), *Handbook of developmental science, behavior, and genetics* (pp. 557–625). Malden, Massachusetts: Wiley–Blackwell.

Joseph, J. (2010b). The genetics of political attitudes and behavior: Claims and refutations. Ethical *Human Psychology and Psychiatry, 12,* 200–217.

Joseph, J. (2011). The crumbling pillars of behavioral genetics. *GeneWatch, 24*(6), 4–7.

Joseph, J. (2012). The "missing heritability" of psychiatric disorders: Elusive genes or non-existent genes? *Applied Developmental Science, 16,* 65–83.

Joseph, J. (2013). The lost study: A 1998 adoption of study of personality that found no genetic relationship between birthparents and their 240 adopted-away biological offspring. In R. Lerner and J. Benson (Eds.), *Embodiment and epigenesis: Theoretical and methodological issues in understanding the role of biology within the relational developmental system. Part B: Ontogenetic dimensions* (pp. 93–124). San Diego: Academic Press.

Joseph, J. (in press). Schizophrenia and heredity: Why the emperor (still) has no genes. In J. Read and J. Dillon (Eds.), *Models of madness: Psychological, social and biological approaches to psychosis* (second edition). London: Routledge.

Joseph, J., and Ratner, C. (2013). The fruitless search for genes in psychiatry and psychology: Time to re-examine a paradigm. In S. Krimsky and J. Gruber (Eds.), *Genetic explanations: Sense and nonsense* (pp. 94–106). Cambridge, Massachusetts: Harvard University Press.

Joseph, J., and Wetzel, N. (2013). Ernst Rüdin: Hitler's racial hygiene mastermind. *Journal of the History of Biology, 46,* 1–30.

Juel–Nielsen, N. (1980). *Individual and environment: Monozygotic twins reared apart*. New York: International Universities Press. (Originally published 1965)

Kamin, L.J. (1974). *The science and politics of I.Q.* Potomac, Maryland: Lawrence Erlbaum.

Kamin, L.J. (1981). Commentary. In S. Scarr (Ed.), *Race, social class, and individual differences in I.Q.* (pp. 467–482). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Kasriel, J., and Eaves, L. (1976). The zygosity of twins: Further evidence on the agreement between diagnosis by blood groups and written questionnaires. *Journal of Biosocial Science, 8,* 263–266.

Kendler, K.S. (1983). Overview: A current perspective on twin studies of schizophrenia. *American Journal of Psychiatry, 140,* 1413–1425.

Kendler, K.S., Neale, M.C., Kessler, R.C., Heath, A.C., and Eaves, L.J. (1993). A test of the equal-environment assumption in twin studies of psychiatric illness. *Behavior Genetics, 23,* 21–27.

Keski–Rahkonen, A., Viken, R.J., Kaprio, J., Rissanen, A., and Rose, R.J. (2004). Genetic and environmental factors in breakfast eating patterns. *Behavior Genetics, 34,* 503–514.

Koch, H. L. (1966). Twins and twin relations. Chicago: University of Chicago Press.

Kringlen, E. (1967). *Heredity and environment in the functional psychoses: An epidemiological–clinical study*. Oslo: Universitetsforlaget.

Långström N., Grann, M., and Lichtenstein, P. (2002). Genetic and environmental influences on problematic masturbatory behavior in children: A study of same-sex twins. *Archives of Sexual Behavior, 31,* 343–350.

Latham, J., and Wilson, A. (2010). *The great DNA data deficit: Are genes for disease a mirage?* The Bioscience Research Project. Retrieved March 20, 2012, from http://independentscience-news.org/health/the-great-dna-data-deficit/

Lerner, R.M. (1995). The limits of biological influence: Behavioral genetics as the emperor's new clothes [Review of the book *The Limits of Family Influence*]. *Psychological Inquiry, 6,* 145–156.

Lewontin, R.C. (1987). The irrelevance of heritability. *Science for the People, 19*, 23,32.

Lewontin, R.C. (1991). *Biology as ideology*. New York: Harper Perennial.

Lewontin, R.C., Rose, S., and Kamin, L.J. (1984). *Not in our genes*. New York: Pantheon.

Loehlin, J.C. (1978). Indentical twins reared apart and other routes to the same direction. In W. Nance, G. Allen, and P. Parisi (Eds.), *Twin research, Part A: Psychology and methodology* (69–77). New York: Liss.

Loehlin, J.C., and Nichols, R.C. (1976). *Heredity, environment, and personality*. Austin: University of Texas Press.

Loewen, P.J., and Dawes, C.T. (2012). The heritability of duty and voter turnout. *Political Psychology, 33,* 363–373.

Luciano M., Kirk, K.M., Heath, A.C., and Martin, N.G. (2005). The genetics of tea and coffee drinking and preference for source of caffeine in a large community sample of Australian twins. *Addiction, 100,* 1510–1517.

Lyons, M.J., Kendler, K.S., Provet, A., and Tsuang, M.T. (1991). The genetics of schizophrenia. In M. Tsuang, K. Kendler, and M. Lyons (Eds.), *Genetic issues in psychosocial epidemiology* (pp. 119–152). New Brunswick, New Jersey: Rutgers University Press.

Martin, N., Boomsma, D., and Machin, G. (1997). A twin-pronged attack on complex traits. *Nature Genetics, 17,* 387–392.

Martin, N.G., Eaves, L.J., Heath, A.C., Jardine, R., Feingold, L.M., and Eysenck, H.J. (1986). Transmission of social attitudes. *Proceedings of the National Academy of Sciences, 83,* 4364–4368.

McClearn, G.E. (1964). The inheritance of behavior. In L. Postman (Ed.), *Psychology in the making* (pp. 144–252). New York: Alfred A. Knopf.

Medland, S.E., and Hatemi, P.K. (2009). Political science, biometric theory, and twin studies: A methodological introduction. *Political Analysis, 17,* 191–214.

Miller, G., Zhu, G., Wright, M.J., Hansell, N.K., and Martin, N.G. (2012). The heritability and genetic correlates of mobile phone use: A twin study of consumer behavior. *Twin Research and Human Genetics, 15,* 97–106.

Moore, D.S. (2001). *The dependent gene: The fallacy of "nature vs. nurture."* New York: Times Books.
Morris–Yates, A., Andrews, G., Howie, P., and Henderson, S. (1990). Twins: A test of the equal environments assumption. *Acta Psychiatrica Scandinavica, 81,* 322–326.
Mowrer, E.R. (1954). Some factors in the affectional adjustment of twins. *American Sociological Review, 19,* 468–471.
Mustelin, L., Joutsi, J., Latvala, A., Pietilainen, K.H., Rissanen, A., and Kaprio, J. (2012). Genetic influences on physical activity in young adults. *Medicine and Science in Sports and Exercise, 44,* 1293–1301.
Neel, J.V., and Schull, W.J. (1954). *Human heredity*. Chicago: University of Chicago Press.
Newman, H.H., Freeman, F.N., and Holzinger, K.J. (1937). *Twins: A study of heredity and environment*. Chicago: University of Chicago Press.
Nichols, R.C., and Bilbro, W.C. (1966). The diagnosis of twin zygosity. *Acta Genetica et Statistica Medica, 16,* 265–275.
Ooki, S. (2005). Genetic and environmental influences on finger-sucking and nail-biting in Japanese twin children. *Twin Research and Human Genetics, 8,* 320–327.
Orey, B.D., and Park, H. (2012). Nature, nurture, and ethnocentrism in the Minnesota twin study. *Twin Research and Human Genetics, 15,* 71–73.
Pam, A., Kemker, S.S., Ross, C.A., and Golden, R. (1996). The "equal environment assumption" in MZ–DZ comparisons: An untenable premise of psychiatric genetics? *Acta Geneticae Medicae et Gemellologiae, 45,* 349–360.
Penrose, L.S. (1973). *Outline of human genetics* (third edition). New York: Crane, Russak and Company.
Pirie, M. (2006). *How to win every argument: The use and abuse of logic*. London: Continuum.
Plomin, R. (2013). Child development and molecular genetics: 14 years later. *Child Development, 84,* 104–120.
Plomin, R., Corley, R., Caspi, A., Fulker, D.W., and DeFries, J.C. (1998). Adoption results for self-reported personality: Evidence for nonadditive genetic effects? *Journal of Personality and Social Psychology, 75,* 211–218.
Plomin, R., DeFries, J.C., McClearn, G.E., and McGuffin, P. (2008). *Behavioral genetics* (fifth edition). New York: Worth Publishers.
Reber, A.S. (1985). *The Penguin dictionary of psychology*. London: Penguin Books.
Richardson, K., and Norgate, S. (2005). The equal environment assumption of classical twin studies may not hold. *British Journal of Educational Psychology, 75,* 339–350.
Rips, L.J. (2002). Circular reasoning. *Cognitive Science, 26,* 767–795.
Rose, R.J. (1991).Twin studies and psychosocial epidemiology. In M. Tsuang, K. Kendler, and M. Lyons (Eds.), *Genetic issues in psychosocial epidemiology* (pp. 12–32). New Brunswick, New Jersey: Rutgers University Press.
Rose, S. (1997). *Lifelines: Life beyond the genes*. New York: Oxford University Press.
Rosenthal, D. (1970). Genetic theory and abnormal behavior. New York: McGraw–Hill.
Rutter, M. (2006). *Genes and behavior: Nature–nurture interplay explained*. Malden, Massachusetts: Blackwell.
Scarr, S., and Carter–Saltzman, L. (1979). Twin method: Defense of a critical assumption. *Behavior Genetics, 9,* 527–542.
Segal, N.L., and Johnson, W. (2009). Twin studies of general mental ability. In Y. Kim (Ed.), *Handbook of behavior genetics* (pp. 81–99). New York: Springer.
Shields, J. (1954). Personality differences and neurotic traits in normal twin schoolchildren. *Eugenics Review, 45,* 213–246.
Siemens, H.W. (1924). *Die zwillingspathologie* [Twin pathology]. Berlin: Springer Verlag.
Smith, K., Alford, J.R., Hatemi, P.K., Eaves, L.J., Funk, C., and Hibbing, J.R. (2012). Biology, ideology, and epistemology: How do we know political attitudes are inherited and why should we care? *American Journal of Political Science, 56,* 17–33.
Smith, R.T. (1965). A comparison of socioenvironmental factors in monozygotic and dizygotic twins, testing an assumption. In S. Vandenberg (Ed.), *Methods and goals in human behavior genetics* (pp. 45–61). New York: Academic Press.
Stocks, P. (1930). A biometric investigation of twins and their brothers and sisters. *Annals of Eugenics, 4,* 49–108.

Sturgis, P., Read, S., Hatemi, P.K., Zhu, G., Trull, T., Wright, M.J., and Martin, N.G. (2010). A genetic basis for social trust? *Political Behavior, 32,* 205–230.

Suhay, E., Kalmoe, N., and McDermott, C. (2007). *Why twin studies are problematic for the study of political ideology: Rethinking "Are Political Orientations Genetically Transmitted?"* Presented at the International Society of Political Psychology. Retrieved July 9th, 2010, from http://sitemaker.umich.edu/suhay/files/critique_of_twin_studies_—_suhay__kalmoe__mcdermott_101007.pdf)

Teo, T., and Ball, L.C. (2009). Twin research, revisionism and metahistory. *History of the Human Sciences, 22,* 1–23.

Tienari, P. (1963). *Psychiatric illnesses in identical twins*. Copenhagen: Munksgaard.

Torgersen, S. (1979). The determination of zygosity by means of a mailed questionnaire. *Acta Geneticae Medicae et Gemellologiae, 28,* 225–236.

True, W.R., Rice, J., Eisen, S.A., Heath, A.C., Goldberg, J., Lyons, M.J., and Nowak, J. (1993). A twin study of genetic and environmental contributions to liability for posttraumatic stress symptoms. *Archives of General Psychiatry, 50,* 257–264.

van der Aa, N., Bartels, M., te Velde, S.J., Boomsma, D.I., de Geus, E.J., and Brug, J. (2012). Genetic and environmental influences on individual differences in sedentary behavior during adolescence: A twin-family study. *Archives of Pediatrics and Adolescent Medicine, 166,* 509–514.

Vandenberg, S.V. (1966). Contributions of twin research to psychology. *Psychological Bulletin,* 66, 327–352.

von Bracken, H. (1934). Mutual intimacy in twins. *Character and Personality, 2,* 293–309.

Wahlsten, D. (2012). The hunt for gene effects pertinent to behavioral traits and psychiatric disorders: From mouse to human. *Developmental Psychobiology, 54,* 475–492.

Wilson, G.D., and Patterson, J.R. (1968). A new measure of conservatism. *British Journal of Social and Clinical Psychology, 7,* 264–269.

Wilson, P.T. (1934). A study of twins with special reference to heredity as a factor determining differences in environment. *Human Biology, 6,* 324–354.

Woodworth, R.S. (1941). *Heredity and environment: A critical survey of recently published material on twins and foster children.* New York: Social Science Research Center

The Journal of Mind and Behavior
Winter 2013, Volume 34, Number 1
Pages 41–62
ISSN 0271–0137

Explaining Consciousness: A (Very) Different Approach to the "Hard Problem"

Paul F. Cunningham

Rivier University

This article addresses what Chalmers called the "hard problem" of explaining consciousness — the problem of experience — in the context of a mediation brain theory in which consciousness is a fundamental feature of physical matter. It presents a novel explanation of how mind-to-brain transmission operates in a way that accounts for the existence of conscious experience. The article explains what is meant by a protoconsciousness inherent in things, its properties and genesis, and how this consciousness accumulates. How consciousness inherent in matter relates to a range of personal identity issues is also discussed. Bold scientific hypotheses and even bolder metaphysical theories are needed to advance the present state of discussion of the problem of how and why brain activity is accompanied by conscious experience.

Keywords: consciousness, mind–brain problem, panpsychism

David Chalmers (1997) stated that explaining why brain processes are accompanied by conscious experience is one of the hard problems facing those seeking a nonreductive understanding of consciousness. Proponents of any mediation brain theory of consciousness face the same problem: How would mind-to-brain transmission operate in a way that accounts for the existence of conscious experience (Cunningham, 2011)? Such an explanation, if it is to advance scientific and philosophic discussion of modern mind–behavior issues, would require "the addition of *something* fundamental to our ontology" that provides a firm groundwork for explaining the existence of consciousness in a nonreductive way (Chalmers, 1997, p. 19). The explanation presented here is admittedly speculative, but it may be "the kind of speculation that is required if we are ever to have a satisfying theory of consciousness" (Chalmers, 1997, p. 22).

Correspondence concerning this article should be addressed to Paul F. Cunningham, Ph.D., Rivier University, Nashua, New Hampshire 03060–5086. Email: pcunningham@rivier.edu

The Electric System of Basic Reality

The first fundamental "something" added to our ontology is the proposition that basic reality is profoundly *multidimensional* (Barrow, Davies, and Harper, 2004; Bohm, 1980; Friedman, 1997; Greene, 2011; Lewis, 1986). There is not one reality — the material one — but a theoretically infinite number of simultaneous, interweaving systems of reality or fields of actuality, one not more real or less real than the others, exerting pressures and influences one upon the other. On the present theory, these alternate systems or fields are open, not closed, and interact with one another. Forces or energies entering these fields, by the very act of entry, become transformed or transduced into the sort of information that can be accepted by the given field so that data passing into it will necessarily be in a different form from the form it had before entry. Because all systems are intimately connected and delicately balanced, an alteration in one field sets up an alteration in each of the others. Although no fields or systems are truly closed and all are interrelated, they appear closed enough in their outer appearance to retain their identity and separateness and to possess their own defining features. These systems or fields, while both individual and unique, are at the same time portions of one unified basic reality. The unity and the separate existence of these different systems of reality may be mathematically deduced (Hilbert and Cohen–Vossen, 1938/1952; Rucker, 1984). They cannot be perceived by the physical senses alone for the simple reason that the physical senses have evolved to not perceive directly any other system of reality but the physical one.

One field of actuality that has particular importance for understanding how mind-to-brain transmission operates is the *electric system of reality*. The electric system is hypothesized to be a distinctively real field of actuality within multidimensional reality that has independent existence outside the physical system with a portion of itself projected into four-dimensional space–time. Everything within the physical field whether or not it exists as matter is electrically composed. This means that the material body with its brain, cells, and organs and the nonmaterial mind with its thoughts, emotions, and dreams have connections with the electric system and exist as forms of electrical action.

The characteristics of the electric system can be perceived most directly and with least distortion in the dream state. In a dream, the dreamer may travel down a road. This involves distance in essence, although within the physical system the particular road does not exist and spatially no distance is traveled. Weeks may be experienced in the dream, while the dream itself may take only a split second of clock time. All action within the electric system involves this same sort of distance without space and duration without time. Distance is in terms of electrical action and duration is in terms of varying electrical intensities. Dreams have this kind of distance and duration. Once created, electrical

action and its electrically coded intensity data cannot be withdrawn, removed or negate itself, and once set in motion cannot be stopped, although there may be counteraction. A dream likewise continues to exist as an ever-moving sphere of more or less separate electrical action within the electric system independent of the dreamer with a life of its own long after the dreamer's awareness of the dream has vanished and the dream has left its point of origin in the self.

All subjectively felt experiences that take up no physical space, including thoughts and emotions, have this kind of independent, objective reality as a distinct, patterned series of electrically coded impulses of particular, unduplicated intensity within the electric system. Their durability within the physical field as an electrical action is determined by their initial electrical charge which is a function of the original intensity of individual intent and desire. Emotions, in particular, can affect other electrical actions and set up influence patterns consisting of strong electrical fields of attraction within each personality initiating what can be referred to as the individual's characteristic *emotional climate*.

The physical system and the electric system, being open, are dependent one upon the other and interrelate continually. The nerve impulses of the material brain connect the two systems. The interrelationships between the two systems are dealt with by the psychological subconscious through its ability to act as a channel between systems of basic reality. Thoughts, emotions, and dreams directly affect the material structure of the body through their connection with the electric system. As independent electrical actions of the mind, thoughts, dreams, and emotions are not bound by or held within the material body, and are not subject to the physical laws that bind the material body. While the material body does not have a primary existence within electric reality, it does exist as a form of electrical action within the electric system.

The electric bodymind. Electrical characteristics of the physical body and brain have long been acknowledged by natural science. Ever since Richard Caton's (1875, 1877) discovery that the brain is associated with its own recordable electrical signals and Hans Berger's report in 1929 that electrical activity could be recorded from the scalp (Brazier, 1970), a constantly fluctuating electromagnetic field in and around the brain has been detected using the electroencephalogram (EEG). EEG signals are spontaneous, affected by mental activity such as attention, generated in the absence of identifiable external stimuli, and vary over time (Shepherd, 1994, pp. 549–554). Direct electrical stimulation of the brain produces subtle and complex patterns of electrical activity and the response recorded depends on the type of neuron stimulated and its metabolic state (Brazier, 1970; Penfield, 1958).

Neurobiologists have discovered that one way neurons transmit information is by transient and rapid alteration of voltage triggered by differences in membrane potential through decreases and increases in electrical charge at synapses with other neurons, triggering the release of excitatory and inhibitory neurotransmitters

into the synaptic gap. Neurons communicate through changes in voltage and the sum total of all the voltage changes produce constantly changing electromagnetic fields in and around the brain. Complex direct current electromagnetic (EM) fields can be detected by measuring differences in electrical potential between electrodes placed on the surface of the skin (Becker, 1990). "These EM fields vary over time, and are highly correlated in regular patterns with growth, development, physiological processes (e.g., ovulation), disease (e.g., malignancies), wound healing and emotional conditions" (Benor, 2004, p. 419). Manipulation of the brain's electromagnetic field can temporarily excite or inhibit local brain activity (Hallet, 2000), momentarily disrupt vision (Blanke, Landis, Spinelli, and Seeck, 2004), cause permanent functional changes in the brain (Liebetanz, Nitsche, Tergau, and Paulus, 2002), or produce a lasting therapeutic effect in the treatment of psychological disorders such as depression (Mayberg et al., 2005). Applying direct electrical energy to under- or over-active neural structures deep within the brain, called deep brain stimulation (DBS), has been reported to play a role in the experience of consciousness, as in the case of the comatose individual who recovered awareness following deep brain stimulation of the thalamus (Schiff et al., 2007).

The mediation brain theory presented here extends these findings by proposing that the body has a corresponding electrical counterpart with which it is intertwined, formed from birth onward that is built up from experiences in physical life. This proto-physical electric body exists within the electric system as a distinct, patterned series of electrical impulses of particular, unduplicated intensity that are retained in electrically coded data within the cells. The idea that the body has an electrically formed counterpart that is not material, has mass but no weight, and possesses varying intensities and concentrations of electrical force may sound quite esoteric. It is, however, a highly practical concept basic to almost all Eastern physiology associated with Yoga and acupuncture (Evans, 1986, pp. 32–52; Gerber, 2001; Swanson, 2011, pp. 137–171).

On the present theory, the electric bodymind refers to an intangible but actual framework composed of electrically coded psychical energy about whose reference points the physical body is constructed. It is a hypothetical construct that has been used to explain certain unsolved problems in biology, such as how morphological forms of the organism are determined, why amputated limbs of certain species are able to regenerate, and where memory is stored (Becker and Selden, 1985; Sheldrake, 1981, 1990). The concept implies that the observed electrical characteristics of the body and mind are a function of their connection to other fields of actuality that do not physically appear. It denotes that the dynamics of health and illness cannot be adequately understood when considered from only a biological standpoint or as a product of the physical field alone (Benor, 2001, 2004; Swanson, 2011, pp. 21–88).

How Mind-to-Brain Transmission Operates

Each thought, emotion, or dream is originally composed of a completely unique pattern of electrical impulses within a particular range of intensity in which every slight variation in intensity is meaningful and distinct. Collectively, these individual intensities form a characteristic electrical field specifically coded to the individual personality. Once created by the self, this pattern of electrically coded data is gathered together and transmitted to the nonmaterial mind which is the connective between the self and the material brain.

The various intensities are decoded by the mind within electric reality and broken down into refinements of intensities, each refinement making possible a fine-tuning of meaning. In the breaking-down process, the intensities of an electrical impulse that compose a particular thought, emotion, or dream action are separated into infinite gradations of varying intensities representing any one of many meanings as its electrical intensity ever so minutely changes. It is for this reason that a rich diversity in psychological symbols is possible, and that one thought, emotion, or dream symbol can have various meanings to many different levels of the personality. The mind attracts within separate fields those electrical impulses in the same general intensity range, and forms from them a pattern of meaningful psychoelectric symbols composed of electrical charges now more meaningful to the entire personality.

After the various electrical intensities have been decoded and collected by the mind, the resultant psychoelectric pattern is telepathically transmitted from the nonmaterial mind in the electric system to the material brain within the physical system. Through a process of transduction, the brain initiates body-wide "reactions" that translate the mind's original psychoelectric pattern into both a more or less pure psychological symbol code meaningful to different sub-conscious levels of the personality and into various groupings of electrical intensities whose effects are experienced in the furthest reaches of the minutest cells of the body. Within the mind, the subjectively felt experience has an electrical reality. Within the brain, it has a psychological reality and a much weaker electrical reality. To the conscious personality (or ego-self), it has only a psychological reality.

Only a small portion of the brain's reactions are detected by current electronic imaging devices because most existing instruments (e.g., EEG, PET, fMRI) are built to detect just the physical energies or forces currently recognized by conventional physical science (i.e., gravitation, magnetism, strong and weak nuclear cohesion). The comparatively weak electrical activity that *is* detectable in the brain and body is but a faint echo emanation or shadow image of the infinite varieties of much stronger and powerful electrical pulsations within the electric system that are currently beyond the range of conventional instrumentation to detect (Becker, 1990; Benor, 2004; Presman, 1970). As more powerful and more

sophisticated computerized electronic imaging systems are developed that combine or go beyond present resonance technologies (e.g., SPECT, SQUID, Kirlian photography), scientists will be able to glimpse more of the electric system (see Gerber, 2001, pp. 106–116, 203–237; Swanson, 2011). Since the electric system's manifestations will not be able to be explained within known physical systems of references, many curious and distorted explanations will be given of the so-called "anomalous" phenomena that are observed.

Elemental telepathy. The mind-to-brain transmission theory presented here is consistent with Tart's (1989, 1993) interactive dualism theory that proposes telepathy to be one of the mechanisms by which a nonmaterial mind interacts with a material body. On the present theory, mind-to-brain transmission occurs by means of "elemental" telepathy to distinguish it from the more advanced, complex form of telepathy studied in parapsychology laboratories where thoughts are transmitted from sender A to receiver B (Irwin, 1989, pp. 57–107; Radin, 1997, pp. 61–89; Rao, 2001; Tart, 2009, pp. 99–113). In its more rudimentary form, telepathic communication occurs whereby intent and desire is conveyed from the self to basically intangible representations of itself (i.e., telepathic structures) that are subsequently materialized into tangible biological structures (e.g., neurons) in the material body. This telepathic mechanism permits the brain to handle basically nonverbal information that is beyond its capacity to translate into neurological terms. These telepathic structures provide the initial inner-ordered framework and invisible pathways around which neurological structures form themselves and that inform their subsequent functioning. Once this telepathic bridge is set forth and the telepathic tracks are laid down, so to speak, the unformed neurological structures have a path to follow on which to materially build.

It is within these elemental telepathic structures of the cell rather than in its physical material that the condensed electrically-coded data of experience are retained. Whole comprehensions thus exist within neurological structures while taking up no space in the physical field. Experiences long forgotten are retained as condensed electrically coded information and continue to exist during the lifetime of the organism and for some time afterwards when the biological material has broken down at the physical death of the body.

Personal identity issues. If thoughts, emotions, and dreams do not originate from within the brain, then who or what is the transmitter and where is it "located"? On the present theory, all experience originates from a self through its subjective action. The "self" as the term is ordinarily conceived in conventional psychology is in actuality a concept of the ego. The ego considers itself the whole self making up the entire identity and "consciousness" confined to those patterns of perception of which it is aware at any particular time. In terms of this discussion, the "self" refers to the aspect of human personality that Roberto Assagioli (1965/1993) called the higher self, F.W.H. Myers (1889–1895/1976) called the

subliminal self, and transpersonal psychologists call the Self that is beyond (trans) ego — the inner self-conscious source self behind the outer self-conscious ego-self — which represents the core identity of the individual.

As a source of action existing within many fields of actuality simultaneously, the source self projects portions of itself within the physical field and sparks into being various identities or ego-selves, each of electrical composition that allows it manipulation within the natural world. The source self's own identity and individuality represents an electrical field of great intensity that is capable of efficiently acting as a unit of consciousness simultaneously within multi-dimensional reality and within the physical field through various egos which direct the overall identity of the conscious personality that is physically oriented. The ego-self (or I-self) of the conscious personality does not perceive this larger scope of activity with which its whole self is constantly involved. Nor does it ordinarily perceive within the subconscious of its own identity the existence of other identities with many such ego-selves.

Psychiatric literature documents the existence of multiple ego-selves within the subconscious psyche of the human personality that may not be aware of each other, even though operating simultaneously (Beahrs, 1982; Braude, 1995; Kelly, Kelly, Crabtree, Gauld, Grosso, and Greyson, 2007, pp. 301–365). The personal subconscious of the dominant ego straddles the psychic actuality of other ego-selves made up of various needs and latent abilities that evolve at other levels of the subconscious and that serve as a resource of potential personalities into which any particular I-self in present time can grow. The source self operates as a relay station and reference point for the seemingly disconnected selves it creates.

Ego-selves do not originally exist within the electrical field, but are products of the physical field, formed from physical birth on and from that point are independent, individual, and unique. Ego-selves do not simply spring into existence, but are the result of psychological experience gained in present and past lives, collectively representing the overall potentials that belong to the whole identity with respect to existence in physical reality. While the bulk of the ego develops through physical heredity and environment, a portion is nevertheless composed of aspects of the source self that gave it birth and thus participates in electrical reality through this connection. Any particular ego gradually builds up an electrical counterpart within electric reality of all the unique experiences, understandings, and knowledge gained by the individual personality over the course of a lifetime. These are also retained in electrical form as condensed coded data within the telepathic structures of the cells of the body. At any given point, the ego-self is as ontologically complete within electric reality as it is psychologically complete within physical reality.

Because the human personality exists in its complete individual form within electric reality, at physical death it escapes the sort of ending that it would ordinarily suffer if it were merely a by-product of brain functioning or more an

integral part of the physical system. Being the product of a source self within whose range of electrical intensities its various ego-selves have their identities assured, the individual personality does not die but upon the biological death of the body its existence is changed from physical reality to electric reality. It can then join or partake of the multidimensional source self of which it is part, and its experiences are added to the total experience of the many personalities that have composed the whole self. The ego-self is still individual, and no individuality is lost in the process. The codified form of the physical senses still exists, and the codified memory of any sensory data that has been experienced may be experienced again. At biological death, the material matter of the organism is discarded as a physical form, as far as the individual personality is concerned, to be used in other combinations of matter.

How Mind-to-Brain Transmission is Accompanied by Conscious Experience

If the preceding account of mind-to-brain transmission is conceptually coherent, still it does not tell why this process should be accompanied by conscious experience. Given the process described, it could just as well be instantiated in the absence of awareness. The intrinsic nature of the entities that compose the nonmaterial mind and the material body need to be further characterized and their causal relevance in giving rise to conscious experience needs to be explained. Chalmers (1997) suggests that an adequate theory of consciousness requires "some entirely new nonphysical feature, from which experience can be derived" (p. 20). To account for conscious experience, the "new nonphysical feature" added to our ontology is the *unit of consciousness* (ψ-bit). The ψ-bit is to be treated as a theoretical entity postulated for the sake of the theory and validated by its explanatory value and contribution to progress in addressing the "hard" problem of explaining how and why mind-to-brain transmission is accompanied by conscious experience.

Unit of consciousness (ψ-bit). The ψ-bit or unit of consciousness represents a fundamental proto-experiential form of inner vitality, action, and identity that constitutes the intrinsic building block of basic reality. The ψ-bit is a basic entity or "unity–identity–whole" that is irreducible (i.e., cannot be broken down further) and resembles what the atom was once thought to be — but is miniscule — and an electron would look huge in comparison. The ψ-bit moves faster than light resembling what the neutrino is now thought to be and its existence may be mathematically deduced. Conceptually, ψ resemble what William James (1909/1947) referred to as "primordial units of mind-stuff or mind dust" (p. 185). Containing within itself all latent identities while retaining its own individuality and identity, a ψ-bit is the fundamental form of consciousness that is the source of all other forms of consciousness, investing everything that it composes

with the qualifications of being. Through the action of these units, consciousness makes its mark on all that is.

A ψ-bit is a form of action that is *awareized* — action that is aware of itself. As awareized action, each ψ-bit contains within itself its own capacity for awareness, intrinsic properties of creative unpredictability and infinite transmutation, and an inherent propensity to move toward organizations and value fulfillments of a cooperative and selective nature. Being endowed with a propensity to explore and fulfill all probabilities of being, the varieties of its manifestations are endless as it strives to create and experience all possible realities and all probable universes. Each ψ-bit fulfills itself by knowing itself through the realities and universes it has created. That knowledge changes it into a greater configuration that then tries to fulfill and know itself further.

ψ-bits can operate either as particles (entities) or as waves (forces). As particles, ψ-bits take on the characteristics of particularity, build up continuity in time, possess specific boundaries taking certain forms, and express their action from the center of these forms. At other levels, ψ-bits operate as waves and inherently possess within themselves all of the information available to the whole resembling what a hologram is thought to be (Pribram, 1989). Their specific nature as particles rests upon this great "body" of inner knowledge. Operating as waves, ψ-bits can appear in several places at once without traversing through space and thus possess the property of nonlocality. They spontaneously exist at all places at once and all of basic reality is interconnected to this extent. The ψ-bit is not a windowless Leibnizean monad closed within itself and is not to be found in isolation. Instead each ψ-bit is intimately related to every other ψ-bit, with each a part of the other, and capable of intermixing and forming in infinite patterns and combinations with other such basic units.

Out of a literally infinite bank of unpredictable events and undifferentiated possibilities, ψ-bits "select" certain ones as significant and of value for fulfillment. The particular kind of significance settled upon results from the individuality of each unit and acts both as a directive for experience and as a method of erecting effective boundaries within which the selected kinds of behavior occur. Within a literally infinite field of activity, meaningful order arises with certain ψ-bits settling upon various kinds of organization, finding these significant, then building upon them and attracting other ψ-bits of the same nature. Certain intensities are built up of unit organization even before the smallest physical particle exists. From their inner organization all physical forms and identities emerge. The body's survival is largely determined by ψ-bits' propensity for selectivity and significance, and the great communication system within the body is dependent upon the constant inner flux and flow of these units.

Different organizations of ψ-bits are the building blocks for the physical matter of rocks, plants, stars, frogs, trees, cells, oceans, continents, and chemical elements.

The natural world is built up from the inside out at each point at which these fundamental units of consciousness assert themselves to form physical reality. The world is not its own source. ψ-bits are also the building blocks for the manufacture of space and the creation of psychological structures and the conceptually complex and difficult to express terms "soul" and "spirit." Units of consciousness or ψ-bits, being the vitalizing force behind all physical processes and psychological actions, are not to be "personified" nor thought to possess human characteristics, even though human characteristics emerge out of what ψ-bits are.

ψ-bits are basically independent of space and time and can move backward and forward and outside of time altogether in a Now that contains past, present, and future. Because ψ-bits have their source in multidimensional reality and outside of physical space and linear time, they are able to form a cellular structure which is able to effectively deal in the most basic manner with the nature of probabilities. The body's apparent stability is dependent upon ψ-bits' clairvoyant knowledge of "future" probabilities and past ones. The ψ-bits that compose atomic structure are poised between probabilities and are aware of their own probable existences, choosing from unpredictable fields of actuality that suit their own particular nature. Every physical form and identity constituted by ψ-bits is a probable one, the result of one line of development out of many that could have been actualized. All other possible lines of development also occur, however, in the creative field of probabilities of a basic reality that is fundamentally multidimensional. The precious privacy of human subjective experience and its probable reality emerges from the infinitely creative field of probabilities that ψ-bits themselves have initiated as they transform themselves into the structured reality that they then become.

Electromagnetic energy unit (E-bit). At some indescribable point, the faster-than-light ψ-bit slows down and "explodes" in a process of transformation into *electromagnetic energy units* (E-bits), the proximate roots of physical matter. E-bits are ψ-bits that have begun the special selectivity and screening process necessary to bring about a particular physical form. E-bits can operate as either waves or particles as ψ-bits do, but are closer to physical orientation, combining in their own fashion to specialize in the various elements which form the most microscopic physical particles that will allow for the production of atoms and molecules perfectly suited to the natural world. There are endless varieties of "matter" between the matter ordinarily recognized and the anti-matter of physicists' theories and the various stages of E-bit proto-matter that gradually coalesce and become physically viable.

By virtue of the underlying E-bits that compose them, every atom and molecule contains within itself a condensed codified comprehension of basic reality as a whole and a memory of all the forms of which it has ever physically been a part, plus a limited but definite self-awareness — *a generalized molecular consciousness* (de Quincey, 2002; Sheldrake, 1981). It is because every atom and molecule

contains within itself this condensed codified comprehension and memory that they are capable of such varied combinations and variations in the creation of matter. Neurobiologists recognize that the cells or atoms of an arm could just as well form an ear or the cells of another portion of the body, for example. The self-awareness and the condensed codified comprehension in each atom and molecule determines what sort of cell or combination of cells that the particular atom or molecule will form. There are gradations of generalized consciousness and self-awareness which are reflected in the multiplicity of structures and diversity of function that appear within physical matter.

The various physical manifestations of consciousness are functions of the configuration of awareized energy that underlies them. Every atom is a conscious atom, every molecule is a conscious molecule, and every cell is a conscious cell, in degree according to its abilities. This means that a rock, a raindrop, a star, a tree, and even manufactured products, such as Chalmers' (1997, p. 27) famous thermostat, are instances of a manifested and an unmanifested consciousness, relatively speaking. Every portion of physically oriented consciousness perceives basic reality and experiences itself from its own privileged viewpoint about which it seems all else revolves. The consciousness of objects is not manifest to humans because the species' range of activities requires boundaries to frame its perception of basic reality in apparent physical terms. Human beings simply do not tune into their range of consciousness.

Atoms and molecules have the opportunity for value fulfillment along many lines that is reflected in their innate capacity for infinite mobility and transmutation and in the endless combinations and arrangements that their cooperation may take in forming stars and frogs, flowers and chairs, cells and organs, bodies and brains. At the death of the organism, the physical matter that composes it is broken down to the state in which it was before the cooperation that formed a particular physical body, freeing the components to once again go back into the physical storehouse to be reused and take form in the creation of other physical matter. This is a function of the latent ability of E-bits to form an almost infinite variety of structures, each one giving forth a truly infinite variety of results and opportunities for further value fulfillment. The universe is not neutral, in these terms.

Combination problem. In the formation of atoms and molecules into individual cells, there is an actual pooling of individual consciousness of atoms and molecules to form the individual cellular consciousness of the physical cells of the body. The literally numberless individual cells similarly combining in the form of individual organs result in the formation of a larger organic consciousness. The organs combine into other patterns forming finally into the physical organism. The whole physical structure of the body itself is the result of this cooperation of organs and cells which are themselves the result of the cooperation of atoms and molecules. This combination of consciousness continues, and its results can

be seen in the consciousness of the physical brain. This process goes on ad infinitum all the way up to the creation of the self-aware conscious personality and beyond ego. The self-awareness of the conscious personality is thus partially composed of the combination of self-aware individual atoms and molecules that compose it, with even the "lowest" particle retaining its own individuality and uniqueness, and not losing any of its original abilities or characteristics, but instead its ability is multiplied.

The combination of individual molecular consciousness results in the creation of a new, enlarged, and more perceptive cellular consciousness that is greater than the consciousness of any individual atom or molecule of which it is composed — different in scope and ability, and capable of much more experience and fulfillment than would be possible for the isolated atom or molecule. The atoms and molecules themselves actually gain immeasurably and share in higher perceptions because of this cooperative combination of consciousness. The resulting pattern of the physical body makes it possible for the organs, cells, atoms, and molecules to express themselves, to share to some degree in the perspective reached through the abilities of a physically large body structure, and to fulfill abilities that would be impossible for them in another context alone. Everything that is maintains its own individuality and uniqueness, identity, and separation, even while it is part of a large and complicated cooperative arrangement, with ensuing benefits. This cooperation extends outward into the natural world and is reflected in the interrelationship and interdependence of the various species in their combined maintenance of the physical universe. Each form of life is created along with each other form — environment and organisms in those terms creating each other (Noë, 2009).

Personal identity issues. It might seem that the conscious personality is merely the result of this combination and recombination. The person is, nevertheless, more than that result, more than the combined consciousness of its atoms. The individual personality is brought together in an overall arrangement of consciousness guided and directed by the overarching purposes and intent of a source self that causes the whole to be more than the sum of its parts. Being the creation of a multidimensional source self, the conscious personality is formed purposely, and not in a random fashion, to function within a definite, particular set of circumstances in physical reality.

The source self projects its vital energy into the physical system with the bulk of its multidimensional consciousness not able to fully materialize in the physical field. Through a process of diffusion, the source self breaks its energy down into simple components and forms the separate atoms and molecules that will compose the individual and disperses itself into many parts. The source self puts its own knowledge into condensed form, telepathically communicates its intent and purpose through inner telepathic patterns, and the atoms and molecules

combine and recombine to form cells, organs, and the whole structure of the physical body, according to the material properties inherent in the physical system.

The mechanism that allows for the formation of complicated patterns into physical form is part of the generalized consciousness of the individual subconscious and performs its function without awareness or comprehension of the conscious personality. The individual subconscious is not some localized region that exists somewhere behind the forehead between the two ears (Ellenberger, 1970). The subconscious is a configuration, formed and maintained by the psychical pooling of the resources and abilities of individual atoms and molecules, chemical elements, and cells that compose the physical body. Built up electrically from the atoms and molecules that make up the cells of the body, the subconscious exists within the electric system and is not basically bound by time, although it may act within time's framework. Each I-self is aware at a subconscious level of the previous affiliations of the atoms and molecules that compose its physical organism and this knowledge can be made known to the conscious personality by expanding its awareness and concepts of personhood (Grof, 1975; Masters and Houston, 1972). Any particular self able to utilize its atoms and molecules as stepping stones could theoretically expand consciousness to contain the universe and everything in it (Forman, 1998).

Vitality, Action, Identity, and the Emergence of Consciousness

The claim is that conscious experience arises as a function of ψ-bits and the combination and recombination of E-bits, but why it arises remains to be explained. As Chalmers (1997) put it, "To account for conscious experience, we need an *extra ingredient* in the explanation. . . [and tell] why should *that* account for conscious experience" (pp. 16–17). We need to add further bridging principles that will explain why experience arises from ψ-bits and the combination of E-bits in the first place. These bridging principles are inner vitality, action, and identity.

Inner vitality. Conscious experience is not derived from units of consciousness or from their pattern of combinations alone. ψ-bits and E-bits and their actions are symbols of another reality that is their source. Inner vitality is the first "extra ingredient" added to our ontology that is behind and causes the units of consciousness from which conscious experience can be derived. Inner vitality is formless in material terms but takes many forms, and is known across many cultures by many names including *chi* (Chinese), *prana* (Indian), *mana* (Polynesian), *wakonda* (Lakota Sioux), and *pneuma* (ancient Greek). It cannot be seen or touched, but its effects can be perceived through its various materializations, while having a reality independent of any and all such materializations (Swanson, 2011). Its materializations do not necessarily result in the construc-

tion of matter within the physical field. Dreams, thoughts, and emotions, for example, represent manifestations of inner vitality that are not materialized within the physical system of matter (i.e., do not take up physical space).

Inner vitality, because of its nature, strives to completely materialize itself in all of its aspects in all systems of basic reality. Inner vitality can never achieve complete materialization, however, despite repeated attempts to do so because those very attempts at outward materialization automatically result in the creation of new vitality, adding a further dimension to inner vitality that also seeks materialization, thus multiplying the possibilities of further materialization, and so the cycle continues ad infinitum and is never completed. The imbalance and tension between the tendency of inner vitality to materialize itself and its inability to completely do so results in an exquisite creative by-product — *action*.

Action. Action is the second "extra ingredient" added to the ontology that is behind and causes the units of consciousness from which conscious experience can be derived. Action is more than motion and is not an outside force, nor is there a separate "force" that causes action. Action is more like growth than force, and has within it the powers of change, development, and expansion. Action is a dimension arising out of existence that results from inner vitality's impulse to fully materialize itself and the practical impossibility of its completely doing so. On the one hand, action represents the spontaneous nature of inner vitality toward expressive materialization that is inherent in all systems of reality, including the physical one. On the other hand, action also approximates as nearly as possible that portion of inner vitality or life force which cannot be completely materialized within any particular apparent form.

Action itself cannot be directly perceived for that reason and cannot be considered separately as a particular thing because it represents the *relationship* between unexpressed inner vitality and materialized vitality. Action, because of its nature, therefore can never be examined from an objective viewpoint. To be examined in such a manner, action would have to be stopped, and any such tampering would cause it to change. Thinking, for example, is a form of action. Thought without action would cease to be thought. If one thought were held forever without termination, then thought would cease to exist because no other thoughts would follow. No action would follow. Action can be experienced directly, however, only when no effort is made to tamper with it. It must be plunged into.

Action necessarily changes any reality which is acted upon and forms from itself a new reality and a new structure. As a form of action, for example, thought acts upon itself and in so doing forms from itself a new thought. Any thought is thus never the same thought from one moment to the next. The thought at any given moment is not the thought that it was, yet it is that which it was, since it is that which changed. For this reason, thought, or a "thought," is not any particular thing. There are no boundaries that enclose it within safe

confines where it can be said, "Here is the thought." There are thoughts within thoughts, with each thought being interwoven with all others. Creating structure from itself, action is always a part of structure that it has acted upon. While not a product of neural structure, thought can never be considered apart from the neural material which it seemingly acts upon, for it becomes a part of that neural structure by its action upon it.

Identity and the emergence of consciousness. Identity is the third element of the ontology and represents the moment point at which conscious experience actually materializes, in the terms of this discussion. Identity is formed from and is the result of action's own workings upon itself. As an aspect of inner vitality, action strives to materialize and fulfill itself completely, although it cannot fully do so. The result of action's effort is the formation of identities that are a part of action and formed from action's action upon itself. As a form of action, each identity continues in this creation of other identities or selves, and while they may change into other selves through action upon itself, they are still themselves, for each new self or identity is also the previous self which changed.

Action, because of its nature, must continually seek change. Identity, because of its nature, must continually seek stability. Yet identity could not exist without action for it is the result of action and so ultimately stability is impossible. Identity must eventually change and can never be constant, just as thought is not the same from one moment to another. The creative tension and dynamic imbalance between identity's constant attempts to maintain stability and action's inherent drive for change results in the original by-product that is *consciousness*. From action's workings upon identity, consciousness is formed. The seemingly miraculous state of consciousness therefore is not a thing in itself. It is a dimension of action. Action turns into consciousness.

Consciousness may be defined as a particular form of action — action that perceives itself. Different forms of consciousness are the result of action's formation of different perception patterns with which it can come to perceive and know certain aspects of itself. Each kind of consciousness represents a different focus of action's perception of itself and is characterized both by the particular ways in which it perceives available action and by the particular form of action that it is more likely to perceive. The type, nature, extent and scope of characteristic perception patterns of any given consciousness determine its physical structure, and not the other way around. This follows from the nature of action being the creator of structure from itself and as being always part of the structure that it has created.

Because it is the nature of action to continually seek change, action constantly forms new and original perception patterns by which it can view and know itself. The new perception patterns are formed one within the other. Within the range of effective perception for any individual consciousness, there will be perception patterns within perception patterns. A particular consciousness

may thus be characterized by its individual configuration of these perception patterns. Consciousness, in these terms, would be defined as a configuration of patterns of perception by which action comes to know itself.

While the definition stands, it can only apply to any given consciousness for an instant, since the patterns of perception, being action, have already changed and the particular consciousness which has been identified and described at any one moment in time has now disappeared. Consciousness, therefore, cannot be considered separately as a particular thing. Being a part of action, consciousness has within it action's characteristic powers of change, development, and expansion. Patterns of perception change and may grow as the particular consciousness reaches out and increases itself by experiencing other patterns of perception. The consciousness has changed, and is no longer the same consciousness, since it has extended itself. Yet in all cases, it is the same consciousness, since it is that which has extended itself and is still present in what it will by now have become. In this manner, stability of identity is maintained through the change of action.

Consciousness of self. Consciousness fulfills itself by knowing itself. One way that consciousness knows itself is through its comprehension of itself as a part *of* action. This form of "action that perceives itself" results in the particular materialization termed *consciousness of self*. A "self" may be defined as a constantly changing, never static configuration of action within (and having composed itself into) a particular range of unique action–perception patterns by which it knows itself as an identity. An atom is an identity in these terms. It is a self materialized in physical form that is conscious of itself as belonging to action and not as apart from action. It is conscious of the arrangements of which it is part in the present, of those configurations of which it has been a part in the past, and of its own probable existences in the future. It is materialized action, an identity that is part of other identities when it joins with other atoms to form cells, and cells to form organs, and organs to form an entire physical organism. The fact that it may be part of a larger pattern of other units of consciousness in no way diminishes its own identity or individuality, which may be of a completely different nature than that with which we are acquainted in usual human terms.

Consciousness of ego. A second way that consciousness knows or is aware of itself is through a derivative and limited but more focused perception of itself as apart *from* action. This form of action results in the particular materialization termed *consciousness of ego*. Consciousness of ego is not the same as consciousness of self. Consciousness of self is still consciousness directly connected with action, and involves an awareness of identity within and as a part of action. Ego consciousness involves consciousness of self outside of and apart from action. Identities may or may not have egos, in these terms.

Ego consciousness (or I-consciousness) is the state that occurs when identity or consciousness of self attempts to stand off from itself, to set itself apart from

action, and to perceive action as an object initiated by itself and as a result of its action rather than a cause of its own existence. Any such separation of action from itself adds to the totality of action, in that it increases action's ability to perceive itself from as many viewpoints as possible. The identity attempts this in order to attain stability and dominance. Identity's efforts to separate itself from action and maintain stability are ultimately fruitless, however, since identity is also action. The resultant ego-self (or I-self) cannot in any way limit the action of the whole self of which it is a part and succeeds only in limiting itself by restricting its perceptions and blocking out many perceptions of which its whole self is knowledgeable. The ego must change since it is and will always remain a part of action.

When the resultant ego-self does change, it tends to change only along certain lines, moving within certain patterns of perception which are characteristic of it. Boundaries may be set up in terms of a self, and an ego could be compared to a small dam, in this respect. Perception characteristics will dictate and limit aspects of action that any individual consciousness can perceive, although any particular form of consciousness is theoretically always free to focus on other aspects. Consciousness is not of itself limiting, in other words. The dimensions of consciousness are open dimensions. The assimilation of other perception patterns would increase, not decrease, any given consciousness. It is only the ego-self which leads the individual identity to believe that such expansion would result in a lessening of consciousness or an invasion of other selves. Yet all selves are one self in that all selves are action. The law of value fulfillment opens the many eyes of the self to its various portions, and enables the ego-self to expand and to join in an organization with other ego-selves. As the effective operational field of perception pattern changes, so do the apparent boundaries of the dominant ego of the conscious personality.

Implications for Explaining Consciousness

The thesis of this article is that consciousness has causal relevance as an intrinsic aspect of physical matter. Consciousness is a materialization of the inner vitality that sustains it and that supports it, and arises as a function of the creative tension between action's dynamic drive for change and identity's inherent attempt to form stable perceptual patterns in which action can view and know itself. The materialization of the human body is constituted by the cooperative action of individual atoms, molecules, cells, and organs that possess their own inner vitality, identity, and action-patterns of perception reflected in the innate, condensed generalized consciousness which informs their physical form. The units of protoconsciousness (ψ-bits and E-bits) that constitute the building blocks of these and other more complicated structures (e.g., human personality) are capable of forming into an infinite variety of arrangements in

which the resulting pattern or organization makes it possible for individual elements to express themselves and fulfill abilities that would be impossible for them in another context isolated and alone.

Brought together into a strong, cohesive identity under the direction and guidance of a source self, the physical organism of the human personality can exist as a separate construction and maintain its own necessary sense of identity. The individual atoms, molecules, cells, and organs that form into such organizations benefit from this cooperative relationship by being able to achieve value fulfillments that simply would not be possible for them in their simpler isolated forms. In this way, all living beings and so-called nonliving things cooperate in maintaining and constantly renewing the material construction of the world and universe of which they are physically a part.

If the presented view is valid, then there is no such thing as "dead" matter and everything which exists is formed by and filled with its own kind of vital consciousness (de Quincey, 2002; Freeman, 2006). This is not to say that the consciousness present in the body's cells or in atoms and molecules is the same as waking human consciousness. It is not. Various action–perception patterns of consciousness-forming units — electrons and protons forming molecules, molecules forming cells, cells forming organs, organs forming organisms, and so forth — result in different kinds of "interior" nature, different qualities of experience, and different ways of perceiving basic reality. There are as many luxuriant and diverse focuses of consciousness as there are forms of life. There are varieties of consciousness so different from our own that we can only approximately grasp the meaning inherent in some of them ("What is it like to be a bat?") [Nagel, 1974]. Human beings are no longer separated from the rest of the natural world by virtue of possessing an inner consciousness. Such consciousness is within all forms of living beings and so-called "non-living" entities.

The proposition that "Consciousness is a function of cerebral action" is both a true statement and a false statement. On the one hand, it is true to say that brain activity gives rise to consciousness inasmuch as it is understood that every neuron and neurotransmitter which exists materially also exists as the physical materialization of *awareized* energy. On the other hand, it is false to say that brain activity gives rise to consciousness inasmuch as it is believed that neural matter and the atoms and molecules and chemical elements of which the brain is composed are inert and lifeless and suddenly through some metamorphosis attain the conscious state in the course of one steady stream of evolutionary development. When consciousness is described as being an attribute of cellular life, the description is used only for convenience, since actually cellular life is an attribute of consciousness and consciousness is an attribute of cellular life.

Consciousness always exists first. Consciousness evolves matter and forms its own materialization; matter does not self-evolve into consciousness (Pfeiffer, Mack, and Devereux, 2007; Skrbina, 2005). The inner vitality and condensed

generalized consciousness behind and within each atom and molecule gave physical construction to the atom and molecule. The individualized and extremely potent bits of energy that compose basic reality — ψ-bits and other units of consciousness — evolve the many different patterns and forms into which each unit of consciousness then manifests itself, and this involves individuality and cooperative interdependence. The intuitive basis of humanity's various God concepts originates in the species' innate knowledge of the basic ontological fact that consciousness preceded physical construction ("In the beginning was the Word"). Consciousness not only created the physical universe but continues to do so on a subconscious basis by each individual identity in it — mineral, plant, and animal.

Albert Einstein (1954, p. 292) once proclaimed that "the eternal mystery of the world is its comprehensibility." Panpsychism's response is that the world is comprehensible precisely because the world and the human intellect are made of the same "stuff." That stuff is consciousness. Panpsychism offers a new metaphysical foundation for the behavioral sciences in the tweny-first century (Harman, 1994) that is very different from its conventional philosophy of science grounded in assumptions of Greek materialism ("Only physical matter actually exists"), Newtonian–Cartesian mechanism ("Matter is composed of lifeless elements devoid of experience or consciousness"), and Occam–Morgan reductionism ("Complex phenomena are really just instances of simpler phenomenon that only appear different") [Grof, 1985; Slife and Williams, 1995, pp. 127–166]. By asserting that consciousness goes "all the way down" to the most basic elements of matter itself, panpsychism overcomes the bifurcation of reality into a world of mind and body or spirit and matter (dualism) and the limiting reduction of basic reality to a world of mind or matter alone (monism). Both matter and consciousness emerge out of what the world is. In certain terms, and despite outward appearances, each is a materialization of the other — ongoing, intertwining actions that are material and conscious at the same time. The spirit speaks with a physical voice and the material body is a creation of the spirit. Only when the two are viewed as radically different things does the gap between the world and consciousness seem unbridgeable and its crossing mysterious.

Conclusion

The basic firm groundwork for the explanation of consciousness presented here is derived from and grounded in and builds upon the channeled texts and derivative theories of Jane Roberts (1975, 1977–1979, 1986; Butts, 1997–2002). Some may consider Jane Roberts's works suspect because of its alleged channeled source. Serious scholarly studies written from a detached point of view and not marred by overt polemical or apologetical considerations have considered the phenomenon to be a fruitful, legitimate, and original source for hypotheses

about the nature of human personality (Beahrs, 1982), physical reality (Friedman, 1994), new religions (Hanegraaff, 1998), epistemological claims (Hammer, 2004), and sociological movements (Heelas, 1996). The aim of this article is to provide an opportunity to examine the so-called "hard problem" of consciousness from an altogether different perspective and to move the discussion forward by presenting a speculative theory that has its roots in ostensible subconscious sources and dimensions of psychological activity that are arguably transpersonal in nature (Hastings, 1991; Liester, 1996; Richards, 1990). Many of humanity's most practical theories have been attributed as coming from subconscious sources (Perkins, 1981). It is reasonable to suppose, therefore, that the present theory contains empirically verifiable propositions that can be evaluated by various "truth-tests" (i.e., correspondence, coherence, pragmatic) [Cunningham, 2012].

In science, hypotheses and theories are not refuted or accepted on the basis of their author's organic or psychological constitution, but are tested by logic and experiment. The origin of a hypothesis or theory is an insufficient basis on which to judge its validity, correctness, or truth. Theories of consciousness — whatever their source — will always retain an element of speculation and remain difficult to test through intersubjective observation. Yet the validity of any naturalistic or even speculative metaphysical account of consciousness can be evaluated by conducting a comprehensive analysis of how empirically verifiable facts predicted by the theory connect with other observations and related predictions, and how the theory can be understood within other theoretical frameworks for understanding phenomena that the theory was designed to explain. As Chalmers (1997) put it, "Even in the absence of intersubjective observation, there are numerous criteria available for the evaluation of such theories: simplicity, internal coherence, coherence with other theories in other domains, the ability to reproduce the properties of experience that are familiar from our own case, and even an overall fit with the dictates of common sense" (p. 22).

Once the fundamental links between energy, matter, and consciousness are recognized, then grand metaphysical speculations concerning the multidimensional nature of basic reality, electrical counterparts of body and mind, elemental telepathy, and units of consciousness are not as implausible as they may appear. Such speculations are intended to serve the heuristic purpose of developing a fundamental theory of consciousness. Bold scientific hypotheses and even bolder metaphysical theories are needed if what currently seems to be inexplicable, mysterious, and beyond the realm of intellectual comprehension — such as the problem of how and why brain activity is accompanied by conscious experience — is ever to be adequately understood and explained.

References

Assagioli, R. (1993). *Psychosynthesis*. New York: Arkana. (Original work published 1965)

Barrow, J.D., Davies, P., and Harper, C.L. (2004). *Science and ultimate reality*. New York: Cambridge University Press.

Beahrs, J.O. (1982). *Unity and multiplicity*. New York: Brunner/Mazel.

Becker, R.O. (1990). *Cross currents*. Los Angeles: J.P. Tarcher.

Becker, R.O., and Selden, G. (1985). *The body electric*. New York: William Morrow.

Benor, D.J. (2001). *Healing research, Volume 1: Spiritual healing, scientific validation of a healing revolution*. Southfield, Missouri: Vision Publications.

Benor, D.J. (2004). *Healing research, Volume 2: Consciousness, bioenergy and healing*. Medford, New Jersey: Wholistic Healing Publications.

Blanke, O., Landis, T., Spinelli, L., and Seeck, M. (2004). Out-of-body experience and autoscopy of neurological origin. *Brain, 127*, 243–258.

Bohm, D. (1980). *Wholeness and the implicate order*. London, England: Routledge.

Brazier, M.A.B. (1970). *The electrical activity of the nervous system*. London, England: Pitman.

Braude, S.E. (1995). *First person plural*. Lanham, Maryland: Rowman & Littlefield.

Butts, R.F. (1997–2002). *The early sessions* (Volumes 1–9). Manhasset, New York: New Awareness Network.

Caton, R. (1875). The electric currents of the brain. *British Medical Journal, 2*, 2.

Caton, R. (1877). Interim report on investigation of the electric currents of the brain. *British Medical Journal, Supplement, 1,* 62–65.

Chalmers, D.J. (1997). Facing up to the problem of consciousness. In J. Shear (Ed.), *Explaining consciousness — the "hard problem"* (pp. 9–30). Cambridge, Massachusetts: MIT Press.

Cunningham, P.F. (2011). Are religious experiences really localized within the brain? *Journal of Mind and Behavior, 32*, 223–250.

Cunningham, P.F. (2012). The content–source problem in modern mediumship research. *Journal of Parapsychology, 76*, 295–319.

de Quincey, C. (2002). *Radical nature*. Montpelier, Vermont: Invisible Cities Press.

Einstein, A. (1954). *Ideas and opinions* [S. Bargmann, Trans.]. New York: Wing Books.

Ellenberger, H.F. (1970). *The discovery of the unconscious*. New York: Basic Books.

Evans, J. (1986). *Mind, body and electromagnetism*. Dorset, England: Element.

Forman, R.K.C. (1998). What does mysticism have to teach us about consciousness? *Journal of Consciousness Studies, 5,* 185–201.

Freeman, A. (Ed.). (2006). *Consciousness and its place in nature*. Charlottesville, Virginia: Imprint Academic.

Friedman, N. (1994). *Bridging science and spirit*. St. Louis: Living Lake.

Friedman, N. (1997). *The hidden domain*. Eugene, Oregon: The Woodbridge Group.

Gerber, R. (2001). *Vibrational medicine*. Rochester, Vermont: Bear & Company.

Greene, B. (2011). *The hidden reality*. New York: Vintage.

Grof, S. (1975). Varieties of transpersonal experiences: Observations from LSD psychotherapy. In S.R. Dean (Ed.), *Psychiatry and mysticism* (pp. 311–345). Chicago: Nelson–Hall.

Grof, S. (1985). *Beyond the brain*. Albany, New York: State University of New York Press.

Hallet, M. (2000). Transcranial magnetic stimulation and the human brain. *Nature, 406*, 147–150.

Hammer, O. (2004). *Claiming knowledge*. Boston, Massachusetts: Brill.

Hanegraff, W.J. (1998). *New age religion and western culture*. Albany, New York: State University of New York Press.

Harman, W. (with Clark, J.). (Ed.). (1994). *New metaphysical foundations of modern science*. Sausalito, California: Institute of Noetic Sciences.

Hastings, A. (1991). *With tongues of men and angels*. Fort Worth, Texas: Holt.

Heelas, P. (1996). *The new age movement*. Cambridge, Massachusetts: Blackwell.

Hilbert, D., and Cohen–Vossen, S. (1952). *Geometry and the imagination*. New York: Chelsea. (Original work published 1938)

Irwin, H.J. (1989). *An introduction to parapsychology*. Jefferson, North Carolina: McFarland & Company.

James, W. (1947). *Essays in radical empiricism and a pluralistic universe*. New York: Longmans, Green, and Co. (Original work published1909)

Kelly, E.F., Kelly, E.W., Crabtree, A., Gauld, A., Grosso, M., and Greyson, B. (2007). *Irreducible mind*. New York: Rowman and Littlefield.
Lewis, D. (1986). *On the plurality of worlds*. Malden, Massachusetts: Blackwell.
Liebetanz, D.M., Nitsche, M.A., Tergau, F., and Paulus, W. (2002). Pharmacological approach to the mechanisms of transcranial DC-stimulation-induced after-effects of human motor cortex excitability. *Brain, 125,* 2238–2247.
Liester, M.B. (1996). Inner voices. *Journal of Transpersonal Psychology, 28*, 1–30.
Masters, R., and Houston, J. (1972). *Mind games*. New York: Dorset.
Mayberg, H.S., Lozano, A.M., Voon, V., McNeely, H.E., Seminowicz, C., Hamani, C., Schwalb, J. M., and Kennedy, S.H. (2005). Deep brain stimulation for treatment-resistant depression. *Neuron, 45,* 651–660.
Myers, F.W.H. (1976). *The subliminal consciousness*. New York: Arno Press. (Reprinted from 1889–1895 Proceedings of the Society for Psychical Research, Volumes 5, 6, 8, 9, 11)
Nagel, T. (1974). What is it like to be a bat? *Philosophical Review, 83*, 435–451.
Noë, A. (2009). *Out of our heads*. New York: Hill and Wang.
Perkins, D.N. (1981). *The mind's best work*. Cambridge, Massachusetts: Harvard University Press.
Penfield, W. (1958). *The excitable cortex in conscious man*. Liverpool, England: Liverpool University Press.
Pfeiffer, T., Mack, J.E., and Devereux, P. (Eds.). (2007). *Mind before matter*. Washington, DC: O Books.
Presman, A.S. (1970). *Electromagnetic fields and life* [F. L. Sinclair, Trans.]. New York: Plenum Press.
Pribram, K. (1989). Behaviorism, phenomenology, and holism in psychology: A scientific analysis. In R.S. Valle and R. von Eckartsberg (Eds.), *Metaphors of consciousness* (pp. 141–151). New York: Plenum Press.
Radin, D. (1997). *The conscious universe*. New York: HarperCollins.
Rao, K.R. (Ed.). (2001). *Basic research in parapsychology* (second edition). Jefferson, North Carolina: McFarland & Co.
Richards, D.G. (1990). Dissociation and transformation. *Journal of Humanistic Psychology, 30*, 54–83.
Roberts, J. (1975). *Adventures in consciousness*. Englewood Cliffs, New Jersey: Prentice–Hall.
Roberts, J. (1977–1979). *The "unknown" reality* (Volumes 1–2). Englewood Cliffs, New Jersey: Prentice–Hall.
Roberts, J. (1986). *Dreams, "evolution," and value fulfillment* (Volumes 1–2). New York: Prentice–Hall.
Rucker, R. (1984). *The fourth dimension*. Boston: Houghton Mifflin.
Schiff, N.D., Giacino, J.T., Kalmar, K., Victor, J.D., Baker, K., Gerber, M., Fritz, B., Eisenberg, B., O'Connor, J., Kobylarz, E.J., Farris, S., Machado, A., McCagg, C., Plum, F., Fins, J.J., and Renzai, A.R. (2007). Behavioral improvements with thalamic stimulation after severe traumatic brain injury. *Nature, 448,* 600–603.
Sheldrake, R. (1981). *A new science of life.* Los Angeles, California: Jeremy P. Tarcher.
Sheldrake, R. (1990). *The rebirth of nature*. London, England: Century.
Shepherd, G.M. (1994). *Neurobiology* (third edition). New York: Oxford University Press.
Skrbina, D. (2005). *Panpsychism in the West*. Cambridge, Massachusetts: MIT Press.
Slife, B.D., and Williams, R.N. (1995). *What's behind the research?* Thorsand Oaks, California: Sage.
Swanson, C.V. (2011). *Life force, the scientific basis*. Tucson, Arizona: Poseidia Press.
Tart, C.T. (1989). Transpersonal realities or neurophysiological illusions? Toward an empirically testable dualism. In R.S. Valle and R. von Eckartsberg (Eds.), *Metaphors of consciousness* (pp. 199–222). New York: Plenum Press.
Tart, C.T. (1993). Mind embodied: Computer-generated virtual reality as a new dualistic-model for transpersonal psychology. In K.R. Rao (Ed.), *Cultivating consciousness* (pp. 123–138). Westport, Connecticut: Praeger.
Tart, C.T. (2009). *The end of materialism*. Oakland, California: New Harbinger.

The Journal of Mind and Behavior
Winter 2013, Volume 34, Number 1
Pages 63–90
ISSN 0271–0137

Psychotherapy and the Brain: The Dimensional Systems Model and Clinical Biopsychology

Robert A. Moss

Bon Secours St. Francis Hospital

The dimensional systems model explains cortical processing on the basis of cortical column interactions, leading to a clinical biopsychological model which involves brain-based psychotherapy integration. The current paper provides a detailed explanation of the interface between these models in relation to psychological treatment. A specific discussion of certain psychotherapy treatment approaches is provided with suggestions on what cortical areas are being impacted. In reference to negative emotional memories there are specific, theoretically based suggestions on how to most effectively neutralize the continuing impact on a client's current psychological functioning. Loss-related depression is explained on the basis of opponent-process theory as related to the brain model. It is hoped that this paper can generate interest among neuroscientists and clinicians to fully evaluate the value of these theoretical models.

Keywords: psychotherapy, cortical column, emotional restructuring, memory

In search of an understanding of how the brain codes, processes, and stores information, two massive projects are in process. The European Union's Human Brain Project (Markram, 2012) and the proposed United States' Brain Activity Map (Alivisatos et al., 2013) both suggest there can be major improvement in treating psychological disorders such as depression and posttraumatic stress disorder if the code is discovered. Both projects emphasize the use of new and better technologies, such as super computers and nanotechnology, to search for the elusive neural code involved in memory and learning. However, neither project description offers any specific theory, or even the level (e.g., molecules, neuron, modules, etc.) of where to look, for the neural code.

William James (1890/1950) was one of the first psychologists to note the fundamental assumption in psychology that neurophysiological mechanisms

Correspondence concerning this article should be addressed to Robert A. Moss, Ph.D., Bon Secours St. Francis Hospital, 1 St. Francis Drive, Greenville, South Carolina 29601. Email: rmoss@emotionalrestructuring.com

underlie both adaptive and maladaptive psychological phenomena (Cacioppo and Berntson, 1992). Sigmund Freud was trained initially as a neuroanatomist and tried to link psychodynamic concepts to neuronal mechanisms in his *Project for a Scientific Psychology* in 1895, although the work was never published during his lifetime since Freud considered it a failure (Northoff, 2012). Despite such early interests, approaches to conceptualizing and treating psychological problems largely developed and remain independent of neurophysiological factors.

In their excellent review on the history on the study of the brain, Kandel and Squire (2000) note the original perspective of psychology was that a neural approach to mental processes seemed too reductionistic. These authors trace the emergence of cellular neuroscience to the 1800s with the work of Santiago Ramón y Cajal and Charles Sherrington. Kandel and Squire (2000) believe that the cellular studies of the 1950s represented the most fundamental advance since the work of Cajal in understanding the organization of the brain. These studies provided evidence of how much neuroscience derived from psychology, as well as illustrating how much psychology could inform neuroscience. In relation to the influential work in the 1950s, Kandel and Squire specifically mention the research of Mountcastle (1957) on the cortical column as one that was instrumental. As will be discussed, the current paper is based on the view that the column is the basic unit in the cortex.

In relation to individual psychotherapy, Greenberg (2002) posits three basic approaches have provided clinical guidance. These are psychodynamic, humanistic/experiential, and behavioral/cognitive–behavioral. There have been some recent attempts to relate these basic approaches to the brain. For example, Northoff (2012) discusses neuropsychoanalysis as using a "function-based approach." In this regard he says that neuropsychoanalysis "aims to link specific psychodynamic mechanisms to the neuronal activity in particular regions of the brain" (p. 2). However, such correlational studies provide little insight into how brain regions may lead to the observed "psychodynamic mechanisms."

The United States Congress declared the 1990s to be the decade of the brain which was followed by American Psychological Association's (1998) declaration of the 2000s as the decade of behavior. These declarations provided implications that dramatic changes in the understanding of psychological problems were at hand. However, the rather sobering article by Miller (2010) on systematic mistreatment suggested that we remain far from such a realization. Miller clearly emphasized that we do not know how psychology–biology causation works and that there are serious costs at the intellectual, clinical, and policy levels by pretending that we do. As he argued, ". . . recent cognitive/affective/clinical neuroscience literature routinely offers interpretations of data with respect to psychological–biological relationships that are not even remotely adequate accounts" (p. 717).

Perhaps the best known brain structure used in conversations by clinicians is the amygdala. This is done often with the failure to articulate the several distinct groups of nuclei in each amygdaloid body that are bilaterally present (i.e.,

paired structures). The role of the amygdala in psychological phenomena such as fear conditioning has clear support (LeDoux and Phelps, 2010). Although subcortical structures play a significant role in many psychological problems, caution is needed not to make the leap in reasoning that complex sensory memories are stored in the amygdala or at some other subcortical level. If such memories were to exist subcortically, this certainly would not bode well for psychotherapy. In other words, how can therapy which is done at the cortical level impact subcortical memory storage? If subcortical negative emotional memory storage actually exists, it is a boon for psychopharmacology since this would realistically appear to be the most effective way of impacting such memories. However, as LeDoux and Phelps (2010) note, both the fast route from the sensory thalamus and the slower route from the sensory cortex converge at the same locations in the lateral amygdala. The involvement of the sensory cortex as both the location of negative emotional memory storage and the source by which activation of the lateral amygdala occurs upon activation of that memory is consistent with the theoretical model discussed in the current paper.

Bassett and Gazzaniga (2011) provided a detailed discussion on the complexity in the investigation of the mind and brain interface. A question posed at the conclusion of their article is "What theories need to be developed to guide further research?" (p. 208). It has been suggested (Moss, 2006; Moss, Hunter, Shah, and Havens, 2012) that the theory needed is one which identifies the manner in which cortical processing occurs and memories are stored. This requires the identification of the code used by the cortex. If the code is based on a binary unit (bit), then it would be possible to theorize how the interconnection of those information units (i.e., the brain) can lead to higher cortical functions (i.e., the mind). If accurate, this theory can then be applied to psychopathology and its treatment.

The current paper provides a brief discussion of a brain model based on the cortical column as the bit involved in all cortical processing and memory. This is followed by a discussion of an applied clinical model which has the potential for providing a brain-based understanding of the development of many aspects of psychological disorders. Based on this model, a specific discussion of some psychotherapy treatment approaches follows with suggestions on what cortical areas are being impacted. In reference to negative emotional memories, a discussion ensues on how to best impact the memories in treatment. Finally, depression tied to loss issues is discussed as related to an inability to stimulate previously stored positive emotional memories.

Dimensional Systems Model

Largely influenced by a Lurian view (see Luria, 1966) of higher cortical functions, Moss (2001, 2006) proposed the dimensional systems model. In relation to cortical processing and memory, five systems were identified. The sensory

input system focuses primarily on tactile, auditory, and visual input as being the most influential in higher functions and results in the manner by which processing occurs in specific cortical areas. The arousal system involves the power supply to the cortex necessary for processing and memory storage which can be selectively influenced based upon ongoing biological needs and emotions. The attention–memory system involves the structures and mechanisms by which incoming sensory information is selected and subsequently stored in memory at the cortical level. The cortical system involves the means by which the columns interact to provide processing, analyses, and responses. Finally, the motor system describes the output level of the system by which environmental manipulations occur. Of key relevance to the clinical applications of the model is that all memory storage occurs at the cortical level and that increased arousal leads to enhanced memory storage.

In an update of the cortical aspects of the model, Moss et al. (2012) discussed the supporting data which had emerged since the 2006 paper and revised certain aspects. A physiological definition of memory was provided as follows:

> A formal definition of memory formation is the strengthening of synaptic connections in any given circuit of cortical columns. The strengthening occurs due to ongoing reactivation of the circuit with resultant increased probability of downstream synaptic activation initially being the result of neurochemical factors (e.g., ionic concentrations, neurotransmitter stores), followed by gradual synaptic structural growth (i.e., increased axonal boutons and dendritic spines). Forgetting is the result of weakened synaptic connections with failure to activate downstream columns in any given circuit. In this case, the probability of a column's activation by one or more other columns fails to be maintained. However, with structural changes such as axonal sprouting and increased dendritic spines between neurons of columns, then the likelihood of "forgetting" is greatly reduced. (pp. 144–145)

There are several important aspects tied to the definition. First, it defines all memory at the cortical level and all memory involves the same mechanisms. Therefore, explicit (i.e., declarative) memory and implicit memory are both circuits of columns, with the qualitative distinction being whether the verbal "interpreter" (Gazzaniga, 2002) has direct access to the memory. As will be discussed, the left lateral ventral frontal area is the purported location of self-talk, or internal verbal dialogue, and is what defines declarative memory (i.e., being able to verbally explain what is being remembered) and allows verbal schemas (Moss, 2001, 2007).

Subcortical enhancement of memory occurs as a function of the activation of the cortical circuit which in turn strengthens the synaptic connections of the involved columns. Increased general arousal via the reticular activating system and increased selective arousal, such as with the amgdala, increase cortical arousal which strengthens the columnar connections. The hippocampus serves to maintain a hippocampo–thalamo–cortico–hippocampo circuit with the goal being strengthening of the synaptic connection among columns. Moreover,

the cortical memories can in turn project to subcortical structures involved in emotions. Thus, when significant emotional sensory memories activate at the cortical level, there is increased activation in associated subcortical structures receiving cortical projections. Since each cortical hemisphere projects ipsilaterally to its own subcortical structures, then the laterality of activation of subcortical structures would correspond to the laterality of the cortical memory.

An important aspect of the current discussion is that emotional memories are stored at the cortical level despite the fact that fMRI studies may not show observable cortical activation following learning and during memory recall. In relation to learning and cortical metabolism as measured by functional magnetic resonance imaging (fMRI), it has been noted (Moss, 2006) in several studies that there is increased activity in frontal and posterior regions in the early stages of learning followed by decreased activity over time. For example, Hempel et al. (2004) monitored cerebral activation associated with a visual spatial memory task during and after four weeks of training. The right inferior frontal gyrus and intraparietal sulcus showed activation increases with improved performance after two weeks of training followed by decreased activation at four weeks. Similarly, long-term cortical negative emotional memories may not result in apparent changes in metabolism when activated although the interconnected subcortical areas would show increased activity. In like manner, novel learning associated with a psychotherapy treatment may lead to measurable increased activity in the cortex around the involved columns only during the acquisition phase with no observed activity change when the columnar connections are well consolidated. These points will be further addressed in the discussion of treatment in relation to the interpretation prior studies.

Moss et al. (2012) suggested several cortical dimensions in relation to the information being coded in a particular column. The medial cortical columns code stimulus information that is internal and self-referential while the lateral cortex codes for external stimuli. Intermediate or transitional zones code for combinations of both. In relation to proximal versus distal to the body stimulus coding, the central sulcus is considered the most proximal cortical location. The post-central sulcus parietal cortical area would code for somatosensory (i.e., body sensation) stimuli. Both vision (occipital lobe) and audition (temporal lobe) involve distal sensory information. The pre-central sulcus primary motor strip involves the body directly while anterior prefrontal processing involves information manipulation largely independent of the body. The parietal, temporal, and occipital lobes contain all receptive, or sensory, information while the frontal lobes code for all action-related information. Ventral cortex processes in a sequential manner and dorsal cortex in a simultaneous manner, with intermediate areas using both modes of processing. Receptive information progresses from less-organized, or lower-order, information to more-organized, or higher-order, information (i.e., coding) as the stream moves away from the primary sensory

receiving areas (i.e., bottom–up processing). On the other hand, the frontal action columns progress in a rostral to caudal more-organized, or higher-order information to less-organized, or lower-order information (i.e., decoding) as the stream goes toward the premotor and primary motor areas. The frontal action columns' control of posterior lobe receptive columns is also present (i.e., top–down processing). Each cortical hemisphere acts as a separate, albeit interconnected, processing unit which means that each of the aforementioned dimensions is contained within each hemisphere. However, there are fewer columns from the time of sensory input to the response level in the right hemisphere. This means that the right cortex can process information faster, but with fewer details. The reader is referred to Moss et al. (2012) for a more complete understanding of these and other aspects of the dimensional systems model. However, these aspects are briefly mentioned here to support the applied clinical model that is now discussed.

Clinical Biopsychological Model

Overview

The clinical biopsychological model was first described in a treatment manual (Moss, 2001). Moss (2007, 2010) subsequently discussed the theoretical aspects of the model as related to negative emotional memories. The studies used in support of the model given in the previous articles will not be repeated and the reader is referred to those articles for those details. Based on the dimensional systems model, the hemispheres are viewed as capable of independent stimulus processing and behavioral responses which means both are equally conscious, though not equally verbal. However, the faster, less detailed processing of the right hemisphere means this side is the best in analyzing non-detailed indices of emotional expression by others, such as facial expressions and voice intonations. It is also the quickest in analyzing and responding to potentially dangerous or threatening external and internal stimuli, particularly along the dorsally located simultaneous information stream. Both positive and negative emotional memories involve the same columns that were used in original processing. The right cortex is expected to have only very limited verbal ability, being mainly related to words associated with the strong expression of emotion (e.g., profanity) and some lyrics housed within music. This restricts the right side to a limited repertoire of independent verbal responses to emotionally related stimuli. Therefore, the right hemisphere is basically restricted to one of three behavioral response patterns. The right cortex can freeze, it can problem solve or attack to overcome the precipitating problem, or it can escape and avoid. I will return to this particular dynamic in relation to interhemispheric congruence and poorly regulated emotional expressions later, as well as in reference to treatment.

The left cortex also has the ability to activate its own connected subcortical structures involved in both positive and negative emotions. This means it has equal ability to activate subcortically-based autonomic responding, as well as the mesolimbic dopamine pathway. However, it processes more detailed aspects and can make responses involving greater complexity, particularly in the verbal realm via the left lateral ventral frontal cortex. The interconnections with the verbal interpreter allow the action columns to directly manipulate the associated posterior cortical receptive columns, providing inhibitory control of affectively undesirable columnar activation and activation of alternative sensory columns (i.e., logical analysis and alternative interpretation or explanation). This same verbal interpreter area is also where the expressed words used in labeling emotions are processed and stored. Of particular importance is this region's role in allowing for an internal verbal dialogue. Based on the dimensional systems model, any action can be done only by the associated frontal columns. Since our verbally thinking to ourselves is an action, it must theoretically occur in the left lateral ventral frontal region. As noted by Gazzaniga (2002), the "interpreter" attempts to make sense of things. He considers it a device, system, or mechanism that seeks explanations for event occurrence. He saw the advantage of an interpreter as allowing more effective coping with similar future occurring events. Notably, Gazzaniga viewed it as only one of the cortical modules that exist. Moss (2001) went one step further and described it as being involved in all verbal-thinking. This could be as simple as reading words in a text and as complicated as writing a detailed theoretical paper. This is not to mean that the sensory processing and memory storage of the words does not occur in the left posterior cortical region; only that when one is actively using the words, it is done in the left lateral ventral frontal area.

Why is the specification of the location of the verbal interpreter so important? From a clinical standpoint, it means that only information being processed cortically that directly interconnects can be recognized and manipulated by this area. Thus, left intrahemispheric processing is much more likely to interconnect to the verbal interpreter than would right interhemispheric processing. In fact, the only direct interhemispheric projections to the left lateral ventral frontal area would be from the right lateral ventral frontal area. If, as has been suggested (Moss, 2007), the non-detailed aspects of emotional memories are located in the posterior regions of the right cortex, there is no means by which verbal-thinking can directly access, label, and influence these memories due to the absence of direct connections. Thus, based on this theoretical model, the left verbal labeling of emotional experiences of the right hemisphere is actually educated guesswork based on experience.

Another relevant factor is tied to excitatory and inhibitory cortical processing. The receptive information in the posterior lobes would logically be excitatory in a feed-forward manner. This would also mean that interhemispheric posterior

lobe communication is always excitatory. In contrast, the frontal lobes have the capacity to provide inhibitory effects on behavior. Given the fact that columnar efferent activity appears to be excitatory (i.e., glutamatergic), there must be a mechanism to otherwise allow this to occur. The basal ganglia appear to be the logical source for such inhibitory effects. This would suggest that the frontal columns involved with any learned action, no matter how concrete or abstract, rely on basal ganglia involvement, as does interhemispheric communication. For example, coordinated movement of both hands in a task requires selective activation and inhibition of each side's motor program. A "braking-system" theory has proposed that the basal ganglia's method of coordinated control is maintaining inhibition of competing motor responses and disinhibition of focal desired motor responses (Mink, 1996). Since motor responses are simply one form of action controlled by the frontal columns, a reasonable extension of Mink's theory is that all other action responses follow the same manner of functioning.

As has been mentioned, each frontal column forms based on the mode of operation of the associated posterior column. Since the posterior column development first involved relatively unorganized information close in proximity to the primary receiving areas, associated frontal columns form in close proximity to the central sulcus. The more complex the information reflected in a posterior column, the further away from the central sulcus will be its frontal column and the higher-order frontal column is interconnected with its previously formed lower-order columns. Just as the posterior columns are excitatory, so would the frontal columns be excitatory. However, by simultaneously circuiting each developing posterior and associated frontal columns' efferent output to the basal ganglia, this could logically allow the necessary inhibitory control. Additionally, the posterior and frontal columns have reciprocal connections to the thalamus. Such a connection pattern would result in a given higher-order frontal column sending output to the basal ganglia's inhibitory (i.e., gamma-aminobutyric acid) circuitry which provides inhibitory output to the thalamic nuclei which in turn provide excitatory input to the initiating frontal columns' lower-order interconnected columns. For the frontal lower-order columns to activate, the basal ganglia inhibitory output to the thalamus must be selectively removed.

From a neuropsychological perspective, this would explain the findings that damage to frontal cortex or damage to the interconnected basal ganglia results in some similar deficits. In this case, the frontal cortex contains the short-term (including working memory) or long-term memory (i.e., columns) for the assessed behavior. Damage to the frontal higher-order column means there is no indirect inhibition (via basal ganglia) or direct excitation to the associated frontal lower-order columns. With sensory input, the uninhibited lower-order frontal columns are activated which leads to the behavior controlled by those columns. For example, on the Stroop color-word inhibition test, rostrally located

higher-order columns are necessary to override the pre-potent color naming response. Damage to those rostral columns prevents the necessary inhibition to override the lower-order columns which involve the well-learned color naming response when presented with the color stimuli. Similar effects can result from damage to the interconnecting frontal column to basal ganglia fibers, or the basal ganglia nuclei themselves. This results in loss of the inhibitory control of the lower-order columns and associated problems in inhibiting the pre-potent color naming response. In relation to psychological problems such as compulsive behaviors and obsessional thoughts, similar problems in inhibition can occur either with dysfunction of frontal higher-order columns, the basal ganglia, or frontostriatal connections.

Based on the dimensional systems model, the hemisphere which can best respond to a given situation is the one that assumes control of the response. This means that the controlling frontal lobe must be capable of inhibiting the other frontal lobe which is capable of producing a competing, incompatible response. Since direct interhemispheric communication is presumably excitatory, the basal ganglia must be responsible for inhibition. Although there can be inter-hemispheric communication among basal ganglia structures controlling the process, there is evidence that in relation to the nucleus accumbens (ventral striatum) shell there are both ipsilateral and contralateral projections from the ventral medial prefrontal cortex (mPFC; Bossert et al., 2012). Contralateral projections would be particularly attractive as an explanation for interhemispheric inhibitory control since it would account for the quickest possible direct inhibitory mechanism limiting the effects of frontal columns in the contralateral cortex. The Bossert et al. study involved context-induced reinstatement of heroin-seeking following extinction. Of particular interest to the current paper was their discussion of results within the context of their previous research. They state:

> These results suggest that only a small minority of context-encoding mPFC neurons mediate context-induced reinstatement. We speculate that this putative context-encoding mPFC "neural ensemble" is comprised of neurons that project to both ipsilateral accumbens shell and contralateral accumbens shell. (p. 4988)

The dimensional systems model (Moss, 2006) suggests that the "neural ensemble" is a cortical column encoding the contextual information. Regardless of the exact connections and mechanisms, interhemispheric inhibitory control leads to several relevant conclusions tied to psychological symptoms in negative emotional states.

The rapid processing in the right hemisphere allows faster response patterns. With situations creating negative emotional responses, the right frontal area would be quickly activated, with potential inhibitory influence on the left frontal lobe. In situations resulting in inhibition of the left lateral ventral frontal

activity, the perceived symptom would be impairment in one's verbal-thinking ability. This can result in problems accessing verbally-based information (e.g., test phobics knowing the material but being unable to access it due to anxiety while being tested) and impaired attention for details. It does not matter if the right hemisphere's excitatory receptive sensory processing is the result of a new aversive environmental stimulus or the activation of significant sensory negative emotional memories (or both), the activation of the right frontal lobe and its inhibitory influence on the left frontal lobe would occur. If the right frontal lobe does not effectively address a situation, the slower left cortical posterior excitatory activity has been ongoing and then activates the left frontal lobe. The left frontal lobe has the ability to exert inhibitory influence on the right frontal lobe to allow it to assume control of the ongoing response. Such parallel processing allows the two hemispheres to simultaneously be involved in any given situation and to employ the most efficient and effective solution. However, there are many situations which are beyond the control of either hemisphere. In this case, such as an unexpected and uncontrollable emotionally overwhelming event, both frontal lobes receive ongoing excitatory sensory input which maintains increased inhibitory influence on the other frontal lobe. This can explain perceptions of emotional numbing and depersonalization. In this case the inhibition creates attenuation of input from the opposing hemisphere, to some degree being functionally detached. This would also account for the observed electroencephalogram pattern reported in some studies of depressed patients in which the right frontal activity is relatively greater than the left (Hecht, 2010), though both frontal lobes would be expected to have decreased activity based on reciprocal inhibition.

An important point of the dimensional systems model is that each side of the brain stores its own memories tied to the processing used. This means that non-detailed sensory emotional experiences are stored in the right posterior lobes, while the non-detailed action or response memories are housed in the right frontal lobe. Due to the fewer number of columns between sensory input and behavioral output, right cortical complete circuit reception-leading-to-action memories are formed faster than in the left. Developmentally speaking, and due to fewer connections in the circuit, the initial right hemisphere's emotional memories are formed prior to the left hemisphere's verbal memories. Depending upon whether there are early positive or negative experiences tied to relationships, these memories will be the ones activated in future situations with others. Just as individuals learn a left hemisphere native spoken language that remains for life, they learn a right hemisphere native emotional language that remains for life. Thus, the sensory emotional memories leading to the activation of positive and negative reactions (i.e., what feels positive and what feels negative to each person) in response to the behavior of others are stored in the posterior right cortex. The behavioral expression memories (i.e., one's "personality") are

stored in the right frontal cortex. Therefore, one's relationship behavior patterns are largely a function of right hemisphere processing and memory. This also serves to explain what occurs in attachment disorders in which physical and emotional closeness is paired primarily with neutral and negative outcomes. In such cases, later physical and emotional contact in relationships activates negative emotional memories and consistently fails to result in competing positive emotions due to the absence of positive sensory memories in the right hemisphere. Additionally, early attachment figures may ignore or punish negative behavioral expressions (e.g., crying) and positive behavioral expressions (e.g., smiling) shown by the infant. This leads to an absence of interpersonal engagement behaviors (i.e., circuits of action columns) since such behavior patterns were not positively reinforced or were punished.

Treatment Considerations

The clinical biopsychological model indicates that there are three sources leading to negative emotional states either singly or in combination. These are ongoing situations, activation of negative emotional memories, or failure to activate positive emotional memories. However, it is also necessary to look at each of these three sources in relation to the impact on each hemisphere and the congruence of frontal activity between the hemispheres. Interhemispheric congruence simply refers to the degree to which there is consistency of the analysis and response of each frontal lobe. The greater the inconsistency, the greater the perceived internal conflict in relation to the behavioral response generated from each hemisphere and the greater the inhibitory input received from the other frontal lobe.

Based on the theoretical formulation that all receptive information processing involves a feed-forward excitatory process, the posterior lobes can be considered passive. The posterior lobes cannot control environmental sensory stimulus input and resultant processing. However, sensory cortex can directly activate subcortical structures such as the amygdala. With subcortical activation, both the sympathetic and parasympathetic systems, as well as the mesolimbic dopamine pathway, can be influenced. Thus, passive does not mean that the posterior lobe processing lacks broad ranging influence. Therefore, right posterior cortical processing can result in autonomic physiological changes (e.g., decreased blood flow to the gut, increased heart rate) without the involvement of the right frontal lobe. This leaves the left lateral ventral frontal interpreter disconnected from the processing and associated effects of the right posterior cortex. In the presence of significant negative emotional memories in the right posterior cortex, there can be both subtle (e.g., decreased gastrointestinal blood flow) and noticeable (e.g., rapid heartbeat) physical symptoms without verbal recognition or awareness of why the symptoms exist. This can account for the manner in which

anxiety and other psychophysiological symptoms can emerge in the absence of verbal "conscious" awareness.

In reference to effective psychological treatment, the frontal lobe action columns are necessarily engaged. Whether practicing relaxation or mindfulness procedures, or engaging in non-directive therapy dialogue, the action columns are responsible for producing the behavior. However, even in the same hemisphere the frontal columns do not necessarily interconnect. Recall that the developmentally earliest frontal lobe columns form in association with and are connected to the corresponding intrahemispheric posterior columns leading to the same type of information coding (e.g., medial cortex involves internal, self-referential information while lateral cortex involves externally related information). The dimensional systems model (Moss, 2006) suggests the existence of multiple frontal attention centers (e.g., dorsolateral cortex manipulating posterior lateral external information columns and anterior cingulate-medial cortex manipulating posterior medial internal information columns), referring to the fact that whichever columns are required in a given task are the ones that activate. This means that different areas in one frontal lobe are responsible for different actions, often with no connections among those areas allowing for verbal interpreter awareness even when it involves other regions of the left frontal lobe. Additionally, action column circuits code for all verbal and non-verbal behaviors, including the maladaptive behaviors observed in clients. This means that treatment based on the dimensional systems model and the clinical biopsychological model can be evaluated on the basis of which frontal columns are involved with a given approach or technique, and whether a given treatment is addressing maladaptive sensory memory processing and maladaptive action processing. Therefore, truly comprehensive treatment involves the inclusion of all relevant bilateral frontal areas.

Ongoing Situations

There are limitless types of situations which can create negative emotional states. Except in early infancy, no sensory processing and associated responses can be considered independent of memory since learning begins early and continues. However, within the context of psychopathology treatment, it is possible to address a client's response pattern to current or anticipated situations employing strategies which require no attempts to deal with past memories. The most obvious theoretical orientation in this regard involves behavioral (e.g., stimulus control, reinforcement contingencies) and cognitive–behavioral (e.g., self-talk, schemas) treatments. It is possible to consider case conceptualization as an ongoing treatment procedure in that conceptualization provides a new schema to explain the development, maintenance, and proposed treatment of a client's problem. At face value it would appear that a conceptualization is only influencing the left cortex since a verbal explanation is involved. However, the verbal descrip-

tions may lead to visualization which can directly influence the right cortex. Additionally, as the left hemisphere recognizes logical and reasonable explanations as to why problems are being experienced, the less there will be perceived internal conflict. In this case, there is improved congruence between the hemispheres as a result of the left frontal recognition that perceived problems are logical and sensible, with concurrent reduction in inhibition of the right hemisphere.

As will be evident in the discussion of each hemisphere and interhemispheric congruence, it is not possible to ever consider either hemisphere as completely independent of the other. The smooth coordination among various intrahemispheric and interhemispheric areas happens in fractions of seconds which allows the emergence of what appears to be a uniform mind. However, the dimensional systems model and the clinical biopsychological model allow a way to dissect the components contributing to the emergent mind in psychotherapy. Verbal-thinking represents only one particular function involving the left lateral ventral frontal cortex. Although this appears to be uniquely human and a very powerful function, it should not be considered "consciousness" since this is only one of many frontal lobe actions. Instead, the term "consciousness" may be better conceptualized as referring to the outputs of cortical action columns, based on receptive column information, that allow meaningful external and internal interactions. Consistent with Gazzaniga's (2010) view on "emergence" in defining the "mind," this definition views all frontal circuits as equally involved in meaningful interactions. The action columns which can best address an ongoing situation are those that assume control, whether or not there is verbal-thinking control or awareness.

When confronted with novel, unexpected, or threatening situations, the right hemisphere is capable of the quickest cortically processed response. Obviously spinal reflexes (e.g., withdrawing one's hand from a hot object) and subcortical orientation responses (e.g., looking toward the source of a sound) are the fastest behavioral patterns, but the right cortical processing allows for the rapid generalized decision of freeze, fight, or flight. Contextual cues are influential since the right cortex efficiently processes them. In relation to process variables (Rogers, 1957), therapist "warmth" is primarily processed in the client's right hemisphere. Non-detailed therapist behaviors such as voice intonation, body position, facial expressions, and eye contact are keys in conveying warmth and acceptance.

Imagery and experience are the two basic ways of influencing the right hemisphere, though in psychotherapy this is typically prompted by therapist verbal interactions and directions with the client's left hemisphere. Although guided imagery may immediately come to mind as a treatment approach, the use of metaphor and analogy are also ways to evoke mental pictures allowing communication with the right hemisphere. Thinking spatially involves the dorsal, simultaneous processing parietal lobes. When spatial visualization occurs, the right

parietal lobe must be involved. This is accessed in therapy when describing an overarching model to allow the client get "the big picture" or "see the forest" prior to giving each of the components. If the client later has a situation in which the model is applied, the right frontal action columns are employed. If the client later explains the model to someone else, there is right hemisphere activation and congruent left hemisphere frontal action column involvement. Herein is a prime example of the importance of the level of overall cortical involvement. If the client only pictures the model (i.e., right posterior involvement), there is no frontal activation. As a result, no impact on the client's subsequent emotions and behavior would be expected. Upon successful application of the model in a situation there is involvement of the right frontal lobe and the client will likely feel improved understanding and control as a result. This application has its main impact in the right hemisphere and can lead to long-term improvement with continued application. In the event that the client teaches the model to someone, there is involvement of the action columns in the left hemisphere which can allow even better detailed application by the client. This would also allow improved interhemispheric congruence since both sides are in concert. Thus, the client both applying the model and verbally teaching it results in bilateral frontal lobe involvement and theoretically is expected to increase therapeutic impact.

In reference to the different approaches directed to teaching relaxation, the clinical biopsychological model suggests what areas of the cortex are involved. Examples of relaxation procedures are progressive muscular relaxation, mindfulness, and meditation. Regardless of the relaxation approach, attention (action involving the frontal columns) is typically focused on internal and external body areas in the beginning of the training procedure. Medial frontal lobe columns allow the action of focusing on internal emotional states housed in the medial parietal region, transitional regions between the lateral and medial cortices (e.g., insula) involve action and sensory visceral activities, and lateral cortex involves any direct voluntary control of the body. Direct voluntary control examples are tightening and relaxing bilateral muscle groups (involving lateral frontal and parietal regions of both hemispheres), repetition of select words or phrases (involving left lateral ventral frontal), and focusing on the sensations of breathing (bilateral frontal ventral lateral and insular, as well as parietotemporal lateral and insular regions). In relation to tensing/relaxing procedures, the premotor and motor regions of the lateral frontal cortex must occur and the sensation changes activate the posterior lateral areas. Repeating phrases or words involves the verbal-thinking region. Both word repetition and tensing would be expected to lead to less activity of the "default network" since there is an active involvement of the lateral cortex. In contrast, focusing on the sensations of breathing largely disengages lateral frontal cortex, particularly in the left hemisphere, and increases activity in the transitional lateral-medial areas

since internal-visceral activities are coded in these regions. With the emerging fMRI studies on mindfulness, meditation, etc., it is possible to theoretically predict what aspects of the procedure being examined should lead to observed cortical responses. If accurate, this may at some point have prescriptive value in choosing various forms of relaxation, mindfulness, and hypnosis based on the disorder and targeted cortical regions. However, there is one important point I will repeat in this paper as it relates to new learning versus old learning. In evaluating brain activity in experienced versus matched naïve-control subjects, Brewer et al. (2011) found that medial frontal and posterior cingulate cortices were relatively deactivated regardless of meditation type. The authors suggested the differences may be related to decreased mind-wandering in experienced meditators. There is an alternative interpretation that can be crucial in avoiding potentially misleading interpretations in this and other studies in which old learning is evaluated via fMRI. In this case, well-learned behaviors will likely result in no generalized cortical activity even though the columnar memory is stored at that location.

When new cortical learning (i.e., a new circuit of columnar connections that is behaviorally efficacious) occurs, there is likely an increase in general local metabolic activity. Moss (2006) suggests this can allow the columns in the circuit to maintain activity with pronounced surround inhibition (i.e., signal) in the presence of general activation of surrounding tissue with the exception of neurons immediately adjacent to the involved columns which are inhibited (i.e., noise). As the columnar connections in the circuit strengthen, there is less generalized local activity. This not only reduces energy consumption, it likely allows the columnar circuit to further strengthen (i.e., signal) based only on the activation of that circuit. Therefore, the absence of increased fMRI activity in well-learned behaviors should not lead to the conclusion that columns in a certain region are not involved.

All psychotherapy procedures necessarily involve the left hemisphere. This is due to the reliance on verbal communication. The verbal behavior of the client is generated by the left verbal interpreter. With adequate case conceptualization which outlines treatment, the client's verbal interpreter has been provided with an organizational scheme which can be used to understand the therapy process, including expectancies of the client's own behavior. Action columns of the left hemisphere are always involved when a client logically decides to remain in a situation leading to perceived emotional distress. Perhaps the best demonstrated fMRI examples involve heightened dorsolateral prefrontal lobe activation in relation to successful fear extinction in anxiety disorders (e.g., Hauner et al., 2012). However, it is important to emphasize that any time a client finds a discussion in therapy leads to emotional distress, the voluntary choice to continue the discussion must involve the frontal action columns. Thus, the finding of frontal activation should not be considered to be exclusive

to certain cognitive–behavioral approaches. If this is accurate, then all forms of effective psychotherapy (both within session and employing techniques in the real world) involve a form of exposure therapy and similar heightened frontal metabolic activity would occur in the areas controlling the new responses (i.e., new columnar connections). This means the left lateral ventral frontal interpreter may be responsible for the decision to remain in a distress producing situation, but may not show fMRI changes since the verbal-thinking does not involve the learning of new words. Metabolic changes would be expected in the right frontal region and newly involved left frontal regions.

In support of this possibility are the data from the Hauner et al. (2012) exposure study in spider phobics. Immediately after successful treatment, there was a rise in cortical activity in the right dorsolateral prefrontal cortex. However, at the six month follow-up, this was no longer evident. The authors concluded that "up-regulation of dlPFC processing, as observed in the short term (immediately after therapy), was not essential for maintaining either long-term therapy gains or long-term amygdala/limbic responses to phobogenic images" (p. 9204). As previously discussed in relation to new versus old learning, a reasonable alternative explanation is that the initial post-treatment rise in dorsolateral prefrontal cortical metabolic activity was essential to allow the new memory consolidation. However, after the memories were effectively consolidated, there was no need for continued general activation. Importantly, this interpretation says that the dorsolateral prefrontal columns are involved in both the acquisition and maintenance of treatment effects.

When there is consistency of bilateral hemispheric information processing and analysis, perceptions of internal conflict lessen regardless of the emotional state. Thus, an individual in an emotional state who verbally thinks and emotionally feels that it is reasonable and acceptable to have that state, has a high degree of interhemispheric congruence. In relation to one of the process variables described by Rogers (1957) which is conveyed by the therapist, both the client's right and the left posterior lobes are impacted in "genuineness." In this case, the therapist communicates truthful and consistent verbal and emotional messages to the client, both based on verbal content and with the heartfelt aspect of the accuracy being conveyed by the therapist's non-verbal behaviors. The result for the client is to process the receptive information in both the right and left posterior cortical columns followed by the associated frontal columns being activated. Since the frontal columns of both hemispheres have consistency, the client will experience minimal conflict. In relation to the process variable of "empathy," the accurate verbal labeling of the client's emotional state results in the client's left verbal posterior processing becoming aligned with the existing right posterior sensory processing or memory activation. In this case the left posterior column activation of the connected frontal columns aligns the left frontal processing with the existing right frontal processing. In

both empathy and genuineness, there is less inhibitory input to each frontal lobe from the other frontal lobe in the client's brain. This would be expected to be perceived by the client as decreased internal conflict.

Improved congruence can result from alterations in action and receptive columns in both hemispheres. The aforementioned act of remaining in anxiety-producing safe situations until emotional distress dissipates, allows the right hemisphere to modify its patterns to align with the left hemisphere's appraisal that there is no danger. The fastest way to improved congruence in therapy appears to be providing the left posterior cortex with logical information that right hemisphere receptive processing and action are expected and reasonable. However, failure to have the client utilize the information which involves the left verbal interpreter will lead to a lack of continued congruence.

Unfortunately, there are many things therapists do which can increase hemispheric incongruence experienced by a client. For example, the all-too-frequently employed question, "Why do you allow yourself to feel that way?" [referring to guilt or some other negative state] immediately registers in the client's left hemisphere with the interpreter concluding that it should somehow have the ability to control the emotion. Based on the clinical biopsychological model, just the opposite is true in relation to right cortical processing. This is an example of how a brain-based model has the potential to identify which therapists' behaviors may have iatrogenic effects (see Moss, 2007, for a more detailed discussion).

Negative Emotional Memories

Since theoretical aspects tied to negative emotional memories based on the clinical biopsychological model have been previously described (Moss, 2007), only the most salient points will be included in the current discussion. First, it is clear that all humans experience a number of situations resulting in negative emotions, but these do not necessarily lead to memories contributing to psychological problems. Therefore, there must be some aspects in relation to the situations that account for such individual differences.

The sensory aspects of negative emotions are stored in the posterior cortical lobes and the associated actions are stored in the frontal lobes. It has been proposed (Moss, 2001, 2007) that the two major situational factors tied to detrimental impact of all negative emotional memories are perceptions or feelings of loss of control and personal inadequacy or responsibility. These two aspects have been similarly noted in relation to traumatic memories by Foa and Rothbaum (1998) where they describe clients' beliefs that the world is totally dangerous and they themselves are completely incompetent. Earlier traumatic and non-traumatic events appear to be very influential in leading to psychological disorders associated with a current trauma (Moss, 2007). In this case, the memories which are formed prior to a traumatic situation are those leading to the maladaptive

client beliefs described by Foa and Rothbaum. Support for this can be taken from a study of posttraumatic stress disorder in a group of Danish soldiers before, during, and after deployment in Afghanistan. Berntsen et al. (2012) found that pre-deployment emotional problems and pre-deployment traumas, especially childhood adversities, were predictors for inclusion in non-resilient trajectories of change while deployment stress was not.

Based on the clinical biopsychological model the right cortical memories are the most influential in leading to maladaptive emotional states and behavioral reactions, yet the most difficult to access in psychotherapy. As previously noted, all psychotherapy necessarily involves the left cortical verbal-thinking region which does not have direct access and control over right posterior memories. The vast majority of all clients the current author has treated over the past 31 years, regardless of diagnosis, had prior influential negative memories, most often involving past and current relationships. Although most people have some degree of feelings of lost control when experiencing a traumatic event, those with prior relationship negative emotional memories are much more prone to experience the personal inadequacy aspect. If only the loss of control aspect is perceived tied to a traumatic event, this will likely be responsive to exposure-based therapies (Moss, 2007). However, in relation to past relationship memories, repeated detailed factual discussions of these memories in psychotherapy leads to little overall improvement and may actually increase distress. Prior to discussing the treatment of relationship negative emotional memories, a discussion of how adaptive functioning tied to memory storage and cortical processing theoretically occurs is warranted.

Only a minority of individuals exposed to trauma experience persistent psychological problems. For example, Housley and Beutler (2007) looked at combined results of three reports and found a 12-month-prevalence rate for posttraumatic stress disorder and acute stress disorder of 12% in the general population. Thus, the majority of people somehow have the resilience to handle trauma. In relation to the clinical biopsychological model, there are several factors which can explain such resilience.

In the right hemisphere, resilient individuals have few posterior cortical receptive negative emotional memories stored with the loss of control and personal inadequacy or responsibility factors. As such, the posterior cortical sensory negative emotional memories tied to past situations or events are necessarily linked to associated frontal action columns in which the situations were adequately handled. In the event of a traumatic situation, the similarity of emotions activate the posterior columns which in turn activate the frontal columns tied to past successful coping behavior. In relation to left frontal cortical memory, successfully managing the past negative emotional situations was likely a result of the logical analysis and response mediated by the verbal interpreter. There is also a strong likelihood that resilient individuals have the verbal-thinking ability

both to label accurately and accept the reasonable nature of negative emotions. In total, these cortical factors result in feelings and thoughts that one is capable of effectively coping with any situation, with the verbal interpreter initiating action to address immediate needs.

In maladaptive functioning, the frontal columns of both hemispheres lack a history of successful and socially appropriate personal control behaviors. In this case, the only right hemisphere generalized behavioral responses of the action columns are to attack, freeze, escape, or avoid. If this is the case, the left verbal-thinking area necessarily lacked a means of effectively dealing with similar situations in the past. Why? Had the left verbal-thinking led to effective control in similar past situations, the left posterior receptive columns would activate when presented with the current event and immediately activate the associated action columns. Based on this theoretical formulation, the right hemisphere is most likely to assume control over responses in those lacking a history of adequate verbal-thinking behaviors.

Given its lack of extensive verbal abilities, the attack response of the right frontal cortex is characterized by loud voice, profanity, or physical assault. If this behavior is observed, there must be a history of at least limited success. However, despite possible immediate success in terminating a negative stimulus, there are obvious longer-term social consequences to such behavior. Although there may be less chance for a loss of control feeling with aggressive behavior, there is unlikely to be a feeling of personal adequacy. The other action responses of freeze, escape, and avoid lead to both loss of control and feelings of personal inadequacy. "Personality" is considered to be the right frontal action column-related behaviors based on the receptive columns (and their associated positive or negative emotional response) which activate in response to relationship behaviors of others. Therefore, "personality disorders" can be defined the same with the only addition being that the relatively stable pattern of behavior is considered maladaptive. Overly manipulative (i.e., aggressive or controlling) action column behavior are characteristic of antisocial, narcissistic, borderline, and obsessive–compulsive patterns. The freeze, escape, and avoid action column behavior are characteristic of avoidant or dependent patterns.

The importance of engaging emotion directly in psychotherapy has been noted by Greenberg (2010). His approach, called emotion-focused therapy, employs experiential techniques which primarily impact the right cortex as based on the current theoretical model. The use of imagery in therapy has also been noted to be of importance for many years (e.g., Lang, 1977). Moss (2001, 2007) advocates for a structured assessment in identifying all potentially relevant relationships (e.g., parents, siblings, school peers, spouse, etc.) since all can contribute to a client's current emotional functioning and a structured treatment approach (i.e., emotional restructuring) to deal with each. This structured treatment includes abundant imagery, as well as role playing and reversals. It is

possible for many clients to experience dramatic changes in both their perceptions and feelings tied to the discussed relationship in a one-to-two-hour session, with immediate impact on current functioning. The impact on current functioning is viewed as the right posterior lobes' receptive columns tied to the prior or current relationship, which are activated by a number of ongoing situations, leading to the activation of new action column memories stored in the right frontal cortex. The newly formed action column memories are associated with perceptions of control and personal adequacy.

Prior to the role reversal and imagery components, the client is provided a description of one of two relationship behavior patterns. The description of the target individual (e.g., mother, spouse, boss) is based on the aforementioned storage of receptive memories in the right hemisphere which determines what feels positive versus negative. The associated right frontally based behavioral strategies to increase positive and decrease negative emotions involve either giving or taking of power, control, attention, or material things in the relationship. A full discussion of the patterns is beyond the scope of the current paper, but is mentioned here in relation to theoretical impact. The verbal interpreter is given a new schema which is sensible, allowing for an alignment of verbal-thinking of the left cortex with the long-standing non-detailed emotional memories of the right hemisphere. Once the pattern is understood, it serves as the basis for assuming the role of the target individual in the role reversal. If the client is successful in assuming the role, there is a reported shift in feelings such that there is a feeling that the target individual is responsible for the problems, not the client. Anxiety declines and anger increases. In this case, the newly formed action column circuits tied to the new schema in the left cortex and the newly formed action column circuits tied to the role-played behavior in the right cortex are consistent.

The imagery is designed to allow release of anger and increase self-nurturance. In most cases, the release of anger involves a described physical assault on the target individual in which the client knows the target individual is incapacitated. This aspect is typically not received well by either seasoned or novice therapists when it is first described. However, it is critical for the best therapeutic outcome. As explained to therapists learning the emotional restructuring process, if one can give the client a described scene lasting less than a minute that can result in permanent improvement in that client's psychological functioning, how is it possible to justify not doing so? Immediately after the anger release imagery scene, the client next receives a description of a funeral in which he realizes that it was not the target individual who died. Instead, the client sees himself in the casket, and then proceeds to engage in a dialogue while hugging the deceased. The conclusion of the imagery scene is the deceased returning to life and expressing gratitude to the client for finally recognizing the reality of what occurred. The typical report of the client at the end is that the anger

is gone and there is a feeling of relief. The final aspects involve providing further information to the client that the target individual was incapable of different behavior due to his own emotional memories, setting up the role play of stated forgiveness which completes the session.

This is obviously only a skeleton version of what is involved, but it is sufficient to apply the theoretical model to each of the imagery components. The visualization of an actual past situation in which the client failed to assert himself is typically used. With the visualized physical assault there are new action column circuits in the bilateral frontal lobes of the client, activated by the new verbal descriptions given to the client's left temporal lobe. These action columns in turn activate associated (i.e., top–down processing) receptive columns in the parieto-occipital region allowing the visualization. In many cases, the client's experience with the target individual has been that any assertive behaviors in response to inappropriate behavior of the target individual results in subsequent problems, thus never truly feeling in complete control. Logically speaking, the only way the right hemisphere can experience feelings of control without fear of retaliation is to physically overcome the person. The experience of the anger expression is perceived by clients as positive in nature. The funeral scene also results in activation of both left lateral ventral frontal columns associated with the nurturing dialogue and the right frontal columns controlling the visualization of caring for the externalized self in the coffin. In total, this allows a mechanism which addresses both loss of control and personal inadequacy tied to the influential memories.

In relation to negative emotional memory treatment, the applied theoretical model has value in evaluating the various procedures currently employed and the degree to which each can effectively engage the frontal lobes bilaterally. This can facilitate communication among therapists with varying orientations since there is a common ground to understand how the brain is being affected.

Positive Emotional Memories

Failure to activate positive emotional memories leads to predictable patterns of reactions. Moss (2001) proposes that an effective way to conceptualize the reactions for the client is based on opponent-process theory (Solomon, 1980). In this regard, an initial positive (or negative) affective state tied to a recurring stimulus shows a gradual reduction in the perceived level of the positive (or negative) affect over time. An opposing affective state is hypothesized to gradually strengthen over time and reduce the experienced level of positive (or negative) affect. If the stimulus is withdrawn, only the negative (or positive) opponent affective state remains. As adapted to explain loss-related depression, the perceived emotional state can be viewed as the summation of the output of both the positive and negative "emotional centers." It is the same as adding a positive

and negative number together. For example, adding a +5 to a –4 leads to a sum of +1. In this case, +1 would still be a positive state, though greatly reduced from the initial +5 state. The most readily apparent logical reason for the existence of an opponent-process system is to ensure the organism continues to engage the environment so that all survival needs are met. In other words, nothing can remain so positive or negative that it interferes with the organism's motivation to engage other aspects of the environment necessary to meet all needs.

Upon the loss of any particular stimulus that has previously been positively rewarding there is deactivation of the positive affective state and only the opponent negative emotional state remains. If the stimulus cannot be restored, the negative emotional state continues over time. There would be a gradual lessening of the negative emotions over time due to the fact that the negative affective state's purpose was simply to off-set (thus, being powered by) the positive state; with the positive center deactivated, there is no means to keep the negative center activated. Eventually, the emotional state tied to the loss of the positive stimulus would return to neutral.

Clients may make a voluntary choice to avoid something considered detrimental despite its associated positive emotions (e.g., addictive substance) or the loss may be involuntary (e.g., death of a loved one). Regardless, the general emotional reaction pattern would be the same when the positive emotional memories are not activated tied to the lost stimulus. Although there is no progression in a smooth and complete fashion from one "phase" to another, the overall pattern is first denial, then dysphoria, then anger, and finally acceptance. Denial refers to a logical, verbal acknowledgement of the loss (left hemisphere) in the absence of extreme negative emotions. This may be related to the previously discussed emotional numbing via left frontal inhibition of right frontal activity in more traumatic events, but can also happen in situations where the full impact has not been fully processed experientially (e.g., getting a diagnosis of spinal cord injury, being told one has lost a job). As an individual participates in the typical daily situations with the loss being evident, the right hemisphere experiences the loss and the left hemisphere can fully assess the detailed changes, at which point the depressive symptoms occur. If the loss is fully accepted as permanent in nature, over time the severe dysphoria lessens and anger feelings emerge. It seems logical that the anger emerges as a function of right frontal action column circuit activation and is important in allowing the establishment of a perceived control aspect (i.e., active responding as opposed to passive acceptance) and attribution of blame for the loss outside of oneself. Both the depression and anger continue to gradually lessen and the individual finally returns to a much more neutral state. In dealing with life loss issues which are permanent in nature, Moss (2001) suggests that education of the client on the normal and expected emotional patterns is very beneficial in allaying anxiety, as well as allowing a realistic evaluation of the limited impact of various treatments (e.g., psychopharmacology).

If complex memory storage occurs only at the cortical level, this is the level at which the opponent-process is triggered when there is loss of a previously rewarding stimulus. However, the involvement of the basal ganglia and limbic structures, such as the amygdala and septum, are also expected. Mink (2008) notes that the ventral striatum receives input from limbic and olfactory cortex, including the amygdala and hippocampus. The ventral striatum (including nucleus accumbens) has reciprocal connections with the ventral tegmental area (part of the mesolimbic dopamine pathway). The ventral pallidum receives input from the ventral striatum and amygdala, with its output going to the dorsomedial nucleus of the thalamus which projects back to limbic cortex. The exact nature of the overall system's role in emotion is not known, though Mink suggests that the inhibitory output of the ventral pallidum may act to suppress or select potentially competing limbic mechanisms. Suppression or selecting competing limbic mechanisms are certainly functions consistent with an opponent-process.

In relation to cortical memories tied to significant loss, there are numerous emotional memories involving the external (lateral cortex) and internal (medial cortex) sensory columns. Specific objects and places memories involve the sequential (ventral cortex) information stream while spatial and contextual memories involve the simultaneous (dorsal cortex) information stream. In the presence of association memories the medial temporal cortex is involved. The loss of positive affect with an ongoing positive stimulus would necessarily involve output from external and internal action columns, though the internal columns (e.g., medial frontal, orbitofrontal) are likely those projecting to the aforementioned ventral basal ganglia system.

Loss can be considered extinction of prior association memories tied to the previously rewarding stimulus. In this case, the various stimuli (e.g., locations, time of day) previously associated with the absent object are experienced. Theoretically, extinction refers to the weakening of synaptic connections that allowed the formation of the temporal cortical columns (i.e., association memories) connected to the lost object's columnar circuit and the associated stimuli (e.g., locations) columns, as well as corresponding frontal action columns tied to the lost stimulus. The exact connections among all columns are only guesswork at this point, but the final result following extinction would be the lack of activation of the medial and orbitofrontal columns connected to the ventral striatum and limbic structures. The end result is that the primary affective state tied to the lost object fails to activate, leaving only the opponent affective process. There will likely be increased generalized metabolic activity (due to this being new learning related to the absent stimulus, or actually "unlearning") around the involved columnar circuits. The generalized activity in the absence of the prior column activation would simply weaken association column activation (i.e., only noise in the absence of the signal). In the case of loss of a previously rewarding stimulus, this would account for any observed metabolic increases in activity in various cortical regions.

Support for distributed cortical effects was provided in two studies on grief (Gundel, O'Connor, Littrell, Fort, and Lane, 2003; O'Connor, Wellisch, Stanton, Eisenberger, Irwin, and Lieberman, 2008). O'Connor et al. compared individuals with complicated grief versus those with noncomplicated grief. Complicated grief is considered present in an individual experiencing excessively prolonged grief which includes recurrent pangs of painful emotions with intense yearning for the loved one. The authors' goal was to elucidate the neural mechanisms associated with both complicated and noncomplicated grief. The independent variables involved a single photograph of the deceased individual versus a stranger and 15 idiosyncratic grief-related words versus 15 neutral words across 60 trials. Composites of each of the photographs and each of the words served as the presented stimuli. The dependent variables involved fMRI measures in regions of interest. There were several pain processing areas (i.e., dorsal anterior cingulate cortex, insula, periaqueductal gray) activated in both groups related to pictures of the deceased individuals and the grief words. However, the only brain area showing relatively greater activity in the complicated grief individuals to the grief related words was nucleus accumbens. Although there was no difference between groups in response to photographs of the deceased, the authors were sensitive to the likelihood of habituation (i.e., new versus old learning) since the same photograph was used in all trials. They then compared groups on the basis of the first third of the trials and found results in which complicated grief participants showed greater nucleus accumbens activation. When the increased nucleus accumbens activation was observed, it was correlated with self-reported yearning for the deceased. No correlation was found between nucleus accumbens activity and length of time since death, participant age, or general positive or negative affect.

The results of the O'Connor et al. study can be used to show the potential of a brain-based theoretical model in psychotherapy. Moss (2001) previously suggested that complicated grief is best conceptualized as a traumatic event phobic-type response, while the loss aspects follow an opponent-process pattern. In this regard, the circumstances of the death represent the trauma and the complicated grief client finds the activation of the traumatic memory painful. The client actively avoids situations, thoughts, and conversations which activate the memories of the loss, including many pre-death memories. Conceptually, these traumatic memories are characterized primarily by loss of control without the personal responsibility aspects and are responsive to exposure procedures. In treatment the client goes through two to three detailed descriptions of the events beginning when the client was notified of the death through the time of returning home after the funeral. Across the one-to-two-hour session, anxiety dissipates and there is improved recollection of details. This generally leads to immediate and dramatic improvement following the client engaging in a brief role play at the end of the session saying "good-bye" to the deceased. Similar

procedures have been described as effective by others (Shear, Frank, Houck, and Reynolds, 2005).

The O'Connor et al. (2008) study shows that nucleus accumbens is involved in response to cortically processed stimuli, both visually and verbally, and appears to be associated with yearning. The yearning is certainly one aspect of what clients report during the dysphoria phase of grieving. For uncomplicated grief, individuals face the environmental stimuli (thereby activating the associated cortical columns) leading to recollection of the deceased, including the reality of the death, on a frequent basis. Consistent with an opponent-process theory, there is gradual deactivation of the associated ventral striatum areas. By avoiding the cortical activation of memories associated with the deceased, the deactivation does not fully occur. In complicated grief subjects in the O'Connor study, with as few as 30 picture presentations, there was an indication of decreased ventral striatum activation tied to that one specific stimulus. Although such a restricted exposure to a single stimulus likely had little therapeutic effect, it can be used to support the brain effect of exposure procedures in the presence of complicated grief. It can also be used to support the value in educating clients on the normal process which is typical of natural reactions to significant loss of any kind (e.g., loss of health, loss of job). In this case, the depressive symptoms are considered normal and the client can be encouraged to be realistic in facing and accepting the loss with the understanding that the depressive symptoms will gradually dissipate over time.

Conclusions

In closing, the current paper has been an attempt to bridge the conceptual divide between a neurophysiological theory and an applied clinical model. The dimensional systems model involves a whole brain model in which the cortical column is the basic unit involved in learning and memory. Based on the purported organization of columns and connection patterns, specific suggestions have been made as to how psychological problems may develop and be addressed in treatment. This has been done to show how applying the neuroscience level dimensional systems model leads to a clinician-level applied clinical biopsychological model which can be used at the client-level of conceptualization and treatment. There have been speculations made here which cannot be proven based on the current literature. However, it is believed there is enough evidence at all levels to support these as viable theoretical models which can be evaluated. It is hoped this can generate interest among neuroscientists and clinicians in fully evaluating the value of these theoretical models.

References

Alivisatos, A.P., Chun, M., Church, G.M., Deisseroth, K., Donoghue, J.P., Greenspan, R.J., et al. (2013). The brain activity map. *Science, 339*, 1284–1285. doi: 10.1126/science.1236939

American Psychological Association. (1998). APA launches decade of behavior. *Monitor on Psychology, 29*(2).

Bassett, D.S., and Gazzaniga, M.S. (2011). Understanding complexity in the human brain. *Trends in Cognitive Sciences, 15,* 200–209. doi:10.1016/j.tics.2011.03.006

Berntsen, D., Johannessen, K.B., Thomsen, Y.D., Bertelsen, M., Hoyle, R.H., and Rubin, D.C. (2012). Peace and war: Trajectories of posttraumatic stress disorder symptoms before, during, and after military deployment in Afghanistan. *Psychological Science, 12*, 1557–1565. doi: 10.1177/0956797612457389

Bossert, J.M., Stern, A.L., Theberge, F.R.M., Marchant, N.J., Wang, H., Morales, M., and Shaham, Y. (2012). Role of projections from ventral medial prefrontal cortex to nucleus accumbens shell in context-induced reinstatement of heroin seeking. *Journal of Neuroscience, 32,* 4982–4991. doi: 10.1523/jneurosci.0005-12.2012

Brewer, J.A., Worhunsky, P.D., Gray, J.R., Tang, Y.Y., Weber, J., and Kober, H. (2011). Meditation experience is associated with differences in default mode network activity and connectivity. *Proceedings of the National Academy of Sciences, 108,* 20254–20259. doi: 10.1073/pnas.1112029108

Cacioppo, J.T., and Berntson, G.G. (1992). Social psychological contributions to the decade of the brain. *American Psychologist, 47,* 1019–1028.

Foa, E.B., and Rothbaum, B.O. (1998). *Treating the trauma of rape: Cognitive–behavioral therapy for PTSD*. New York: Guilford.

Freud, S. (1895). *Project for a scientific psychology*. London: Hogarth Press.

Gazzaniga, M.S. (2002). Consciousness. In V.S. Ramachandran (Ed.), *Encyclopedia of the human brain* (Volume 2, pp. 31–35). New York: Academic Press.

Gazzaniga, M.S. (2010). Neuroscience and the correct level of explanation for understanding mind: An extraterrestrial roams through some neuroscience laboratories and concludes earthlings are not grasping how to best understand the mind–brain interface. *Trends in Cognitive Sciences, 14,* 291–292. doi:10.1016/j.tics.2010.04.005

Greenberg, L.S. (2002). Integrating an emotion-focused approach to treatment into psychotherapy integration. *Journal of Psychotherapy Integration, 12,* 154–189.

Greenberg, L.S. (2010). The clinical application of emotion in psychotherapy. In M. Lewis, J.M. Haviland–Jones, and L.F. Barrett (Eds.), *Handbook of emotions* (pp. 88–101). New York: Guilford.

Gundel, H., O'Connor, M.F., Littrell, L., Fort, C., and Lane, R.D. (2003). Functional neuroanatomy of grief: An fMRI study. *American Journal of Psychiatry, 160,* 1946–1953.

Hauner, K.K., Mineka, S., Voss, J.L., and Paller, K.A. (2012). Exposure therapy triggers lasting reorganization of neural fear processing. *Proceedings of the National Academy of Sciences, 109,* 9203-9208. doi: 10.1073/pnas.1205242109

Hecht, D. (2010). Depression and the hyperactive right-hemisphere. *Neuroscience Research,* 68, 77–87. doi: 10.1016/j.neures.2010.06.013

Hempel, A., Giesel, F.L., Caraballo, N.M.G., Amann, M., Meyer, H., Wustenburg, T., et al. (2004). Plasticity of cortical activation related to working memory during training. *American Journal of Psychiatry, 161,* 745–747.

Housley, J., and Beutler, L.E. (2007). *Treating victims of mass disaster and terrorism*. Cambridge, Massachusetts: Hogrefe.

James, W. (1950). *Principles of psychology* (Volume 1). New York: Dover. (Original work published in 1890)

Kandel, E.R., and Squire, L.R. (2000). Neuroscience: Breaking down scientific barriers to the study of brain and mind. *Science, 290*, 1113–1120.

Lang, P.J. (1977). Imagery in therapy: An information processing analysis of fear. *Behavior Therapy, 8,* 862–886.

LeDoux, J.E., and Phelps, E.A. (2010). Emotional networks in the brain. In M. Lewis, J.M. Haviland–Jones, and L.F. Barrett (Eds.), *Handbook of emotions* (pp. 159–179). New York: Guilford Press.

Luria, A.R. (1966). *Higher cortical functions in man*. New York: Basic Books.
Markram, H. (2012). The human brain project. *Scientific American, 306*, 50–55. doi: 10.1038/scientificamerican0612-50
Miller, G.A. (2010). Mistreating psychology in the decades of the brain. *Perspectives on Psychological Science, 5,* 716–743. doi: 10.1177/1745691610388774
Mink, J.W. (1996). The basal ganglia: Focused selection and inhibition of competing motor programs. P*rogress in Neurobiology, 50,* 381–425.
Mink, J.W. (2008). The basal ganglia. In L. Squire, D. Berg, F. Bloom, S. Du Lac, A. Ghosh, and N. Spitzer (Eds.), *Fundamental neuroscience* (pp. 725–750). New York: Academic Press.
Moss, R.A. (2001). *Clinical biopsychology in theory and practice*. Greenville, South Carolina: Center for Emotional Restructuring.
Moss, R.A. (2006). Of bits and logic: Cortical columns in learning and memory. *Journal of Mind and Behavior, 27,* 215–246.
Moss, R.A. (2007). Negative emotional memories in clinical treatment: Theoretical considerations. *Journal of Psychotherapy Integration, 17,* 209–224. doi:10.1037/1053-0479.17.2.209
Moss, R.A. (2010). Clinical biopsychology: Could a grand theory actually exist to allow true psychotherapy integration? *Independent Practitioner, 30,* 67–71.
Moss, R.A., Hunter, B.P., Shah, D., and Havens, T.L. (2012). A theory of hemispheric specialization based on cortical columns. *Journal of Mind and Behavior, 33,* 141–172.
Mountcastle, V.B. (1957). Modality and topographic properties of single neurons of cat's somatosensory cortex. *Journal of Neurophysiology, 20,* 408–434.
Northoff, G. (2012). Psychoanalysis and the brain — why did Freud abandon neuroscience? *Frontiers in Psychology, 3,* 1–11. doi: 10.3389/fpsyg.2012.00071
O'Connor, M.F., Wellisch, D.K., Stanton, A.L., Eisenberger, N.I., Irwin, M.R., and Lieberman, M. D. (2008). Craving love? Enduring grief activates brain's reward center. *Neuroimage, 42,* 969–972. doi: 10.1016/j.neuroimage.2008.04.256
Rogers, C.R. (1957). The necessary and sufficient conditions of therapeutic personality change. *Journal of Consulting Psychology, 21,* 95–103.
Shear, K., Frank, E., Houck, P.R., and Reynolds, C.F. (2005). Treatment of complicated grief: A randomized controlled trial. *Journal of the American Medical Association, 293*, 2601–2608.
Solomon, R.L. (1980). The opponent-process theory of acquired motivation: The cost of pleasure and the benefits of pain. *American Psychologist, 35,* 691–712.

The Journal of Mind and Behavior
Winter 2013, Volume 34, Number 1
Pages 91–100
ISSN 0271–0137

The Flow of Time as a Perceptual Illusion

Ronald P. Gruber

Stanford University Medical Center

Richard A. Block

Montana State University

This article discusses theories and evidence on the flow of time as a perceptual illusion. The flow of time is said to be a stubborn illusion, although it has never been experimentally verified. There is a high-level flow of time (the experiential phenomenon of the past, present, and future), as well as a low-level flow of time, *happening*, which includes spatial change (motion). The hypothesis is that the latter, happening, component of the flow of time is a perceptual illusion. Previous research reveals that motion perception occurs in discrete processing epochs, frames, or snapshots. Apparent motion is painted onto each snapshot, and motion is not experienced because of a change in position between two consecutive snapshots but is represented within a single snapshot. When people view video scenes of a walking man and toasting bread with a wide range of interstimulus intervals, fewer of them could "see it happening" as the interstimulus interval was increased. This suggests that happening, whether involving a color change or a motion, is a frequency-dependent percept. It can be eliminated, for example, by choosing the appropriate stimulus frequency. The low-level component of the flow of time is therefore a perceptual illusion.

Keywords: time, time perception, flow of time, percept, illusion

Einstein said that "the past, present and future are only illusions, even if stubborn ones," that create a (false) impression that time is flowing (Davies, 2002, p. 41). However, no experimental evidence supports that contention. Before investigating the hypothesis that the flow of time is an illusion, we shall examine what is meant by "flow of time," a phenomenon which has been discussed in detail by

We gratefully acknowledge the advice of Stuart Anstis at the inception of this research project and again following completion of the manuscript. We are also grateful to Harry Foundalis, who provided important commentary and suggestions. This article is based on a plenary talk presented at the meeting of Toward a Science of Consciousness, Tucson, Arizona, April 2012. Correspondence concerning this article should be addressed to Ronald P. Gruber, M.D., Stanford University Medical Center, Stanford, California 94305. Email: rgrubermd@hotmail.com

Foundalis (2008), Hameroff (2003), Penrose (1989) and Smart (1980). It appears that the sense that time is flowing may be a more complicated phenomenon than is generally thought. There are actually two components to the flow of time (Davies, 1996) that should be distinguished. The commonly used expression, "flow of time," refers to the experiential phenomenon of events seeming to move from the future into the present and then into the past, a moving present that seems to flow like a river, hence the term (Segal, 2004). The experimental phenomenon of a moving present is what we will refer to as a high-level component of the flow of time. We use the term "high level" because as an experiential phenomenon it involves a somewhat higher (more complicated) cognition.

The high-level flow of time is in contradistinction to what we refer to as a low-level flow of time — the experiential phenomenon one receives from perceptual encounters such as spatial change (motion), color change, and auditory change. The low-level flow of time involves a less complicated perception, similar to that of fundamental or primary sensations. An exploding volcano is a low-level example. It involves the perception of change for three sensory modalities (the movement of the lava, the changing sky color, and the sound of the explosion). We focus on the low-level flow of time in this article, and it is the component that we hypothesize to be a perceptual illusion.

To clarify the meaning of the low-level flow of time, Gibson (1975) argued that "a sequence of external stimuli . . . provide[s] a *flow of change*, and it is this we perceive rather than a flow of time as such" (p. 299). He added that "the observer perceives both what is altered and what remains unaltered in the environment" (p. 298). Park (1999) agreed, suggesting that "discussions of time become more clear if one drops the word 'time' entirely and substitutes one of the words '*event*' or 'change' " (p. 20). Block (1998) expanded Gibson's argument and claimed that successive changes of events provide a source for the common spatial representation of the flow of time, "a straight line being steadily drawn in one direction" (p. 120). All three theorists seem to agree that avoiding the word "time" makes it easier to understand what is meant by the flow of time. At the very least, the expression "flow of time" is best replaced with the expression "flow of events."

However, there is a caveat. Participants in our studies (Gruber and Block, 2012) had difficulty expressing their perception when they were required to use phrases like flow of time or flow of events. Empirically, we found that the best term was *happening* (e.g., "Yes, I could see it happening. I sensed his motion"; or "No, I could not see it actually happening. But the individual slides told me he must have gone from one side to the other." Happening is a percept not only for spatial change but color and sound change as well.

Advocates of the notion that happening (the low-level flow of time) is an illusion include most post-Einstein physicists (Barbour, 1997, 2000; Greene, 2005). This is because the block universe theory of Einstein (Davies, 2002) suggested

that the universe is in essence a four-dimensional spacetime manifold, a universe consisting of slices of spacetime and one in which all of the events within each slice are said to be *just there*. However, the notion that events are just there does not mean that an observer should be able to perceive them simultaneously. At any point in time, the theory expects an observer to experience an event and also the memory of a past event. The next point in spacetime should result in a similar experience but without a special connection, a flow or a happening attributable to the adjacency of two events. More specifically, there is no need to account for the experiential phenomenon of motion in this well-accepted theory. A few theorists advocate the notion that the classic interpretation of the block universe theory is not correct. On the basis of chaos theory and irreversibility principles, Prigogine (1980) suggested that the subtle physics of irreversible processes make the flow of time an objective aspect of the world — not an illusion. In his spacetime dynamics theory, Elitzur (1991, 1996) argued much the same, as did Ellis (2008), that spacetime "grows" in the future direction.

Illusions and Happening

Anstis (2009) [see also Gregory, 1991; Zakay, 2009; Zakay and Bentwich, 1997] reviewed the meaning of the term "illusion." The simplest way to know if a percept is an illusion is whether or not it contradicts any laws of physics. In the event that is not possible, one must look towards the characteristics of illusions. An illusory percept, unlike the percept of external stimuli, is one that if removed or eliminated, no consequence (such as the loss of incoming information) should result.

The present hypothesis is that happening (the low-level flow of time) is a perceptual illusion. Therefore, to assess the validity of that hypothesis one should be able to demonstrate that (1) happening can be eliminated (i.e., Einstein's illusion is not all that stubborn), and (2) when eliminated, the percept of happening is irrelevant.

Happening for Spatial and Color Events

Noting that the illusion of the phi phenomenon is stimulus frequency-dependent (Steinman, Pizlo, and Pizlo, 2000) in that it exists only at certain frequencies, we decided to determine whether or not happening is also a frequency-dependent percept. If it is, perhaps it is an illusion similar to the phi phenomenon. Specifically, we decided to determine the effects of major stimulus frequency alterations on the low-level flow of time (happening) for both spatial and color stimuli as a test of the hypothesis (Block and Gruber, in press; Gruber and Block, 2012). In these experiments, video scenes of a walking man and bread turning brown in a toaster, using interstimulus intervals of 0.5, 3.0, and 7.0 s, were shown

to participants.[1] Participants judged whether or not they could see motion of the walking man and the toast changing color. More specifically, they had to judge whether the events (walking or toasting) had actually "happened" or those that "must have happened."

As the interstimulus interval increased, fewer participants experienced happening. Specifically, at an interstimulus interval of 0.5 s, most participants in the walking and toasting conditions responded with "happening." At an interstimulus interval of 7.0 s, many fewer participants in both conditions responded with "happening." What is important is that as the interstimulus interval increased beyond a critical level, the "flow of events" reverted to a "sequence of events" (cf. Gibson's [1975] sequence of external stimuli). Events became relatively static. Moreover, participants in the study perceived all relevant information from observation of the walking man, such as duration between stimuli and their chronology. Because the percept of happening (e.g., motion) could be eliminated without losing any relevant visual information, these results suggest that the flow of events (happening) is a frequency-dependent perceptual illusion.

Change Detection and Motion Perception

Similar results have been found by others, although their interpretations differed. Instead of using the term happening, some researchers use the term *change detection*, in particular, dynamic change versus completed change (for a review, see Rensink, 2002). Using an informal flicker paradigm, Hollingworth (2008) presented participants with one visual scene (for a duration of 250 ms) immediately followed by another (of that duration) that was slightly different (e.g., absence of a chimney that was previously present), while varying the interstimulus interval (200 ms, 1000 ms, or 5000 ms). Participants reported having a strong impression of "seeing the change occur" at 200 ms, a weaker impression at 1000 ms, and no impression of seeing the change occur at 5000 ms. Nakashima and Yokosawa (2012) basically replicated Hollingworth's experiment, and our results show similar decrements with progressively increasing interstimulus intervals but a shift to longer interstimulus interval values — perhaps because we used real life situations and asked specifically if motion was sensed.

[1]In our experiment (Block and Gruber, in press), ten frames were played, each for 100 ms, with an interstimulus interval between frames (stimuli) of 0.5, 3.0 and 7.0 s. In the case of the experiment involving a walking man, participants were asked to answer either: A — "Yes, I could see it happening. I sensed his motion across the parking lot"; or B — "No, I could not see it actually happening or sense his motion. But the individual slides told me he must have gone from one side to the other." In the case of the experiment involving toasting, participants were asked to answer either A — "Yes, I could see it actually happening. I saw it become toasted"; or B — "No, I could not see it actually happening. But the individual slides told me it must have become toasted."

Two studies examined motion perception at longer interstimulus intervals. Palmer (1986) presented participants with two points of light for 1.0 s and then after a variable delay (up to 8.0 s) moved one of the points of light to the side. Participants did not report movement beyond delays of 200 ms. Bex and Baker (1999) used moving arrays of textured micropatterns. In their pilot study, displacement of a single patch (at an interstimulus interval of 1.0 s) was not accompanied by the subjective appearance of movement. Our study (Block and Gruber, in press) importantly differs from theirs in that they involved multiple, sequential stimuli of complex biological scenes. It appears that the percept of motion is easier to elicit from multiple episodic events.

There are other examples in which interstimulus interval manipulation generates illusory percepts. As the interstimulus interval is altered for illusory element motion, it is replaced by group motion (Scott–Samuel and Hess, 2001). On a more familiar level, time-lapse photographers recognize that the stimulus duration has to be reduced to a critical level before a budding flower comes alive, becomes dynamic, and happens. Thumbing through a flipbook also results in a dynamic motion of the scene when the critical rate (stimulus duration) is reached.

Illusions and Continuous Motion

To further appreciate the fact that happening is frequency-dependent, we contrast the above results to the illusory percept of continuous motion by discrete sampling (Crick and Koch, 2003, 2007; VanRullen and Koch, 2003; VanRullen, Reddy, and Koch, 2010). The wagon-wheel illusion is perhaps the best experimental example. If the wheel is viewed in continuous (not stroboscopic) light and the rotation rate is increased, a speed is reached in which the wheel appears to turn in reverse. This phenomenon suggests that the brain undergoes a visual sampling rate of approximately 13 Hz. Koch (2004) suggested that motion is painted onto each snapshot, and that motion is not experienced because of a change in position between two consecutive snapshots. In essence, the brain creates an illusion of continuous motion. However, the wagon-wheel experiment does not prove that continuous motion does not actually occur. Even if it was a percept that could be eliminated, the percept of continuous motion is not irrelevant in the experiment: it is a percept that provides necessary information about the stimulus (the wheel location at any point in time).

The illusion from discrete sampling resembles the illusion that provides richness to our visual world when our vision is interrupted by saccades (Blackmore, Brelstaff, Nelson, and Troscianko, 1995). In addition, the discrete temporal sampling rate (13 Hz) is close to the predicted rate of discrete conscious events in the Penrose–Hameroff model for what the researchers called orchestrated objective reduction (Orch OR), which is estimated at 40 Hz in some cases (Hameroff, 2001; Woolf and Hameroff, 2001).

The Illusion of Music

One other related frequency-dependent illusion is an auditory one — music. Although commonly thought of as a quale (Gregory, 1998; for a review of qualia see Duch, 2005), music is a superimposition of a non-informational illusory percept on an underlying stimulus complex. It is a superimposed aesthetic percept on the physical perception of the auditory stimuli (e.g., pitch, frequency, and volume). Music is also a frequency-dependent percept. Consider the four most recognized musical notes from Beethoven's Fifth Symphony. Anyone who has participated in a symphony orchestra, and who has played those four notes at progressively increasing intervals between them, knows that when one reaches an interval of 4.0 s between notes, Beethoven's Fifth Symphony is no longer identifiable to many listeners and does not even sound like music.

Some patients suffer a disorder involving a deficit in musical memory and recognition despite normal hearing, a condition referred to as amusia. A few of these amusia patients, when listening to a symphony, may hear all the sounds (pitch, frequency, and volume) that emanate from the musical instruments but simply do not experience music (Sacks, 2007). Clearly, music is irrelevant for auditory information purposes. Unlike other qualia (e.g., color which is not irrelevant for information purposes), music is also a perceptual illusion. As mentioned above, happening includes spatial change (motion), color change, and auditory change. Music is an example of an auditory change that happens to be a superimposed perceptual illusion. In that sense it is very much related to the illusory percept of motion.

Specious Present

The specious present (Block, 1979; Gruber, 2008; Kinsbourne and Hicks, 1990; Ruhnau, 1997), often referred to as the *now*, has a duration that is ill-defined but is about 3.0 s for many perceptual phenomena (Pöppel, 1985, 1997), shorter than the original estimate of 6.0 s by William James (1890). Our pilot studies were done initially with an interstimulus interval of 3.0 s because it was suspected that as a result of by-passing the now (presenting the second stimulus more than 3.0 s after the first) the stimulus would become a relatively old memory.

We conjectured that upon retrieval of that older lower-density memory, to compare it to a more recent higher-density memory, the brain would likely not be able to superimpose an illusory percept upon the older, lower-density memories. Our finding that the happening percept was more completely lost at the 7.0 s interstimulus interval than at 3.0 s interstimulus interval reveals that the illusion is likely related to the frequency per se and not the by-passing of the now.[2]

[2]S.M. Anstis, personal communication, November, 10, 2010.

Becoming versus Happening

How does one reconcile the above findings with the spacetime dynamics theory (Elitzur, 1991, 1996), Prigogine's (1980) approach to uncertainty, and chaos theory which insist that "events are becoming," and therefore the flow of time is not illusory? It is our contention that the low-level flow of time is an illusion that is not incompatible with Prigogine's and Elitzur's theories. Implicit in their theories is that becoming leads to a percept for a single event, a percept that is characterized by awareness of the observer that the event has come into existence. The participants in our experiment actually did experience awareness for the onset of each frame of the walking person.

However, that awareness for a single event (stimulus) is not the same as the happening they experienced when serial frames (events) were presented. When the interstimulus interval was sufficiently prolonged, there was awareness for the emergence of each frame of the walking man, but not a percept of happening. The (low-level) flow of time (requiring two or more events) is a different experiential phenomenon than the awareness of a coming-into-existence of a single event (stimulus). "Becoming" is not "happening." However, the illusory percept of happening is not precluded from and does not contradict Prigogine's or Elitzur's theories.

Other Speculations

The suspicion that the motion component of happening is a perceptual illusion is not new. Based upon the observation that a few patients saw the world as a cinematographic sequence of stills (a condition referred to as *akinetopsia*), Sacks (2005b, p. 35) raised the question of whether the continuous passage of time and movement is an illusion, "whether in fact our normal visual experience consisted of a series of 'moments' which were then welded together." Referring to the neurological findings of Sacks (1970), Koch (2004) remarked that rare migraines temporarily inactivate cortical motion areas, "thereby depriving . . . patients of the illusion of motion" (p. 266). In other words, the illusion of motion is necessary for normal cerebral functioning.

Based on what we now know about the percept of the flow of time, it is possible to speculate as to what the perception of events would be like if it were possible to eliminate the illusion of happening (including motion) at high frequencies (short interstimulus intervals). Our best guess is that the visual world would look like a series of stills at a rate of approximately 13 Hz (the estimated discrete processing rate of the brain). However, unlike the perception of happening (motion) that people currently experience from a 13 Hz movie, the perception of motion while observing the series of stills would be absent. The experiential phenomenon at a 13 Hz rate would be as devoid of motion as observing one

frame of a movie every 7 s (the interstimulus interval in our experiments when almost all participants lost the percept of motion). The demonstration of that experiential phenomenon at high frequencies is a stubborn problem awaiting future experimentation. It would be ideal to eliminate the percept of happening without having to reduce the stimulus frequency. Then there would be no question that the percept of happening is an illusion. To that end, it may be necessary to use methods other than frequency variation (e.g., transcranial magnetic stimulation) that are effective in disrupting various forms of perceptual motion, such as apparent rotary motion (Ruzzoli, Gori, Pavan, Pirulli, Marzi, and Miniussi, 2011) and the motion after-effect illusion (Theoret, Kobayashi, Ganis, DiCapua, and Pascual–Leone, 2002). However, our findings reveal that frequency variation is a powerful method to study why time seems to flow.

References

Anstis, S.M. (2009). Visual illusions. In T. Bayne, A. Coleeremans, and P. Wilken (Eds.), *Oxford companion to consciousness* (pp. 363–367). Oxford: Oxford University Press.

Barbour, J.B. (1997). Nows are all we need. In H. Atmanspacher and E. Ruhnau (Eds.), *Time, temporality, now* (pp. 201–216). Berlin: Springer Verlag.

Barbour. J.B. (2000). *The end of time.* Oxford: Oxford University Press.

Bex, P.J., and Baker, C.I. Jr. (1999). Motion perception over long interstimulus intervals. *Perception & Psychophysics, 61,* 1066–1074.

Blackmore, S.J., Brelstaff, G., Nelson, K., and Troscianko, T. (1995). Is the richness of our visual world an illusion? Transsaccadic memory for complex scenes. *Perception, 24,* 1075–1081.

Block, R.A. (1979). Time and consciousness. In G. Underwood and R. Stevens (Eds.), *Aspects of consciousness: Volume 1. Psychological issues* (pp. 179–217). London: Academic Press.

Block, R.A. (1998). Psychological time and the processing of spatial information. In M.J. Egenhofer and R.G. Golledge (Eds.), *Spatial and temporal reasoning in geographic information systems* (pp. 119–130). New York: Oxford University Press.

Block, R.A., and Gruber, R.P. (in press). Time perception, attention, and memory: A view of theories and evidence. *Acta Psychologica.*

Crick, F., and Koch, C. (2003). A framework for consciousness. *Nature Neuroscience, 6,* 119–126.

Crick, F., and Koch, C. (2007). A neurobiological framework for consciousness. In M. Velmans and S. Schneider (Eds.), *The Blackwell companion to consciousness* (pp. 567–579). Malden, Massachusetts: Blackwell.

Davies, P. (1996). *What is time?* New York: Simon and Shuster.

Davies, P. (2002, September). That mysterious flow. *Scientific American, 3,* 40–47.

Duch, W. (2005). Brain-inspired conscious computing architecture. *Journal of Mind and Behavior, 26,* 1–22.

Elitzur, A.C. (1991). Consciousness and the passage of time: Two persistent wonders — or one? *Frontier Perspectives, 2,* 27–33.

Elitzur, A.C. (1996). Time and consciousness: The uneasy bearing of relativity theory on the mind–body problem. In S.R. Hameroff, A.W. Kaszniak, and A.C. Scott (Eds.), *Toward a science of consciousness* (pp. 837–850). Cambridge, Massachusetts: MIT Press.

Ellis, G.F.R. (2008). *On the flow of time.* Essay for the FQXi contest on the nature of time. Retrieved from arxiv.org/pdf/0812.0240

Foundalis, H.E. (2008). Why does time 'flow' but space is? Answers in evolution and cognition. Essay for the FQXi contest on the nature of time. Retrieved from fqxi.org/community/forum/topic/276

Gibson, J.J. (1975). Events are perceived but time is not. In J.T. Fraser and N. Lawrence (Eds.), *The study of time II* (pp. 295–301). New York: Springer Verlag.

Greene, B. (2005). *The fabric of the cosmos*. New York: Vintage.

Gregory, R.L. (1991). Putting illusions in their place. *Perception, 20,* 1–4.
Gregory, R.L. (1998). Snapshots from the decade of the brain–brainy mind. *British Medical Journal, 317,* 1693–1695.
Gruber, R.P. (2008). Neurophysics of the flow of time. *Journal of Mind and Behavior, 2,* 239–254.
Gruber, R.P., and Block R.A. (2012, April). *Experimental evidence that the flow of time is a perceptual illusion.* Paper presented at the meeting of Toward a Science of Consciousness, Tucson, Arizona.
Hameroff, S. R. (2001). Consciousness, the brain and spacetime geometry. In P.C. Marijuán (Ed.), *Cajal and conciousness: Scientific approaches to consciousness on the centennial of Ramon y Cajal's* Textura (pp. 74–104). New York: Annals of New York Academy of Sciences.
Hameroff, S.R. (2003). Time, consciousness and quantum events in fundamental spacetime geometry. In R. Buccheri, M. Saniga, W.M. Stuckey, and North Atlantic Treaty Organization. Scientific Affairs Division (Eds.), *The nature of time: Physics, geometry and perception*. NATO science series, Series II, Mathematics, physics, and chemistry, v. 95 (pp. 383–392). Amsterdam: Kluwer Academic.
Hollingworth, A. (2008). Visual memory for natural scenes. In S.J. Luck and A. Hollingworth (Eds.), *Visual memory* (pp. 123–162). Oxford: Oxford University Press.
James, W. (1890). *The principles of psychology*. New York: H. Holt.
Kinsbourne, M., and Hicks, R.E. (1990). The extended present: Evidence from time estimation by amnesics and normals. In V. Giuseppe and T. Shallice (Eds.), *Neuropsychological impairments of short-term memory* (pp. 319–330). New York: Cambridge University Press.
Koch, C. (2004). *The quest for consciousness*. Englewood, New Jersey: Roberts.
Nakashima, R., and Yokosawa, K. (2012). Sustained attention can create an (illusory) experience of seeing dynamic change. *Visual Cognition, 20,* 265–283.
Palmer, J. (1986). Mechanism of displacement discrimination with and without perceived movement. *Journal of Experimental Psychology, 12,* 411–421.
Park, D. (1999). What is "time"? In M. Wegener (Ed.), *Time creation and world order* (pp. 15–22). Aarhus, Denmark: Aarhus University Press.
Penrose, R. (1989). *The emperor's new mind.* New York: Oxford University Press.
Pöppel, E. (1985). *Mindworks: Time and conscious experience*. Boston: Harcourt, Brace, Jovanovich.
Pöppel, E. (1997). The brain's way to create "newness." In H. Atmanspacher and E. Ruhnau (Eds.), *Time, temporality, now* (pp. 107–120). Berlin: Springer Verlag.
Prigogine, I. (1980). *From being to becoming: Time and complexity in the physical sciences*. San Francisco: Freeman.
Rensink, R.A. (2002). Change detection. *Annual Review of Psychology, 53,* 245–277.
Ruhnau, E. (1997). The deconstruction of time and the emergence of temporality. In H. Atmanspacher and E. Ruhnau (Eds.), *Time, temporality, now* (pp. 53–70). Berlin: Springer Verlag.
Ruzzoli, M., Gori, S., Pavan, A., Pirulli, C., Marzi, C.A., and Miniussi, C. (2011).The neural basis of the enigma illusion: A transcranial magnetic stimulation study. *Neuropsychologia, 49,* 648–655.
Sacks, O. (1970). *Migraine*. London: Faber and Faber.
Sacks, O. (2005a). In the river of consciousness. In T. Folger and J. Wiener (Eds.), *Best American science and nature writing* (pp. 216–227). New York: Houghton Mifflin.
Sacks, O. (2005b, March 24). Remembering Francis Crick. *The New York Review of Books*, pp. 34–36.
Sacks, O. (2007). *Musicophilia: Tales of music and the brain*. New York: Vintage.
Scott–Samuel, N.E., and Hess, R.F. (2001). What does the Ternus display tell us about motion processing in human vision? *Perception, 30,* 1179–1188.
Segal, E. (2004). The mind's direction of time. *Journal of Mind and Behavior, 25,* 227–236.
Smart, J.C.C. (1980). Time and becoming. In P. Van Inwagen (Ed.), *Time and cause: Essays presented to Richard Taylor* (pp. 3–15). Boston: Reidel.
Steinman, R.M., Pizlo, Z., and Pizlo, F.J. (2000). Phi is not beta, and why Wertheimer's discovery launched the Gestalt revolution. *Vision Research, 40,* 25–32.
Theoret, H., Kobayashi, M., Ganis, G., DiCapua, P., and Pascual–Leone, A. (2002). Repetitive transcranial magnetic stimulation of human area MT/V5 disrupts perception and storage of the motion after effect. *Neuropsychologia, 40,* 2280–2287.
VanRullen, R., and Koch, C. (2003). Is perception discrete or continuous? *Trends in Cognitive Sciences, 7,* 207–213.

VanRullen, R., Reddy, L., and Koch, C. (2010). A motion involved illusion reveals the temporally discrete nature of visual awareness. In R. Nihawan and B. Khurana (Eds.), *Space and time in perception and action* (pp. 521–535). New York: Cambridge University Press.

Woolf, N.J., and Hameroff, S.R. (2001). A quantum approach to visual consciousness. *Trends in Cognitive Science, 5,* 472–478.

Zakay, D. (2009). Time, illusion of. In H. Birx (Ed.), *Encyclopedia of time: Science, philosophy, theology, and culture* (pp. 1271–1273). Thousand Oaks, California: Sage.

Zakay, D., and Bentwich, J. (1997). The tricks and traps of perceptual illusions. In M.S. Myslobodsky (Ed.), *The mythomanias: The nature of deception and self-deception* (pp. 73–103). Hillsdale, New Jersey: Erlbaum.

Critical Notices
Book Reviews
Book Notes

The Journal of Mind and Behavior
Winter 2013, Volume 34, Number 1
Pages 101–104
ISSN 0271–0137

Clinical Psychology: An Introduction. Alan Carr. New York: Routledge, 2012, xviii+395 pages, $39.95 paperback, $150.00 hardcover.

Reviewed by Geoffrey L. Thorpe, University of Maine

Alan Carr directs the clinical psychology training program at University College Dublin. He wrote *Clinical Psychology: An Introduction* to introduce undergraduate students to clinical psychology as a profession, covering psychological assessment, the leading models of psychotherapy, a selection of topics within psychopathology, and the scientific evidence supporting current interventions. One of the five learning objectives for the first chapter, "What is Clinical Psychology?," is to enable students to plan their careers so as to increase the likelihood that they will qualify for admission to a clinical psychology graduate program. Carr focuses upon the 30 doctoral programs in England, Scotland, and Wales and the five in the Republic of Ireland and Northern Ireland. These are three-year training programs that lead not to a PhD but to a doctorate in clinical psychology, such as the D Clin Psych. Gaining admission to such programs is presented as a daunting process that typically requires a background in both clinical and research experience, including already-earned graduate degrees. Concerning the academic qualifications of successful applicants, Carr writes: "[C]andidates with better secondary school results, higher undergraduate grades, master's and PhD degrees, more favourable academic references and greater research achievements and publications are more likely to be admitted to clinical psychology programmes" (p. 13). Each of these 35 three-year programs involves a partnership between a university and a public health service unit. The training philosophy is most commonly that of the scientist–practitioner.

Because of its emphasis on training and practice in Ireland and the United Kingdom, this book will have only limited relevance to American or Canadian students, who will be likely to find the specific material on training programs irrelevant and the coverage of public health settings in the British Isles unfamiliar. Yet the substantial presentations on psychopathology and diagnosis follow American and international classifications (American Psychiatric Association, 2000; World Health Organization, 1992), and the detailed material on assessment and psychotherapy draws from a common knowledge base shared by researchers and practitioners on both sides of the Atlantic.

Carr has not described the entire range of psychopathology, and the book's compass would have seemed arbitrarily limited if this had been a book on abnormal psychology

---

Correspondence concerning this book review should be addressed to Geoffrey L. Thorpe, Psychology Department, Room 372, 5742 Little Hall, University of Maine, Orono, Maine 04469–5742. Email: Geoffrey.thorpe@umit.maine.edu

— which, in many respects, it resembles. For example, the chapter on childhood disorders describes only attention-deficit/hyperactivity disorder (ADHD), conduct disorder, and oppositional/defiant disorder. Neither the specific or general learning disabilities nor the pervasive developmental disorders are reviewed. The rationale for focusing entirely upon the disruptive behavior disorders is that clinical psychologists are more often called upon to deal with them than with other disorders. Furthermore, Carr notes that the emotional disorders (e.g., anxiety and mood disorders) are considered elsewhere in the book. Nonetheless, the depth of Carr's presentations compensates for the limited scope. The section on ADHD includes a case illustration with family history, psychological and developmental assessment, formulation, and therapy; detailed information on epidemiology, definitions and diagnostic criteria, and theories of etiology, encompassing genetics, neuro-anatomical irregularities, neurotransmitter dysregulation, diet, hypo-arousal, and executive function; and assessment, cognitive–behavioral treatment, and family systems interventions. Under each heading a wealth of information is presented in considerable depth. Familiarity with such concepts as the dopamine transporter gene (DAT1), the dopamine D4 receptor gene, frontostriatal circuitry, the ventral tegmental areas of the brain, and the locus coeruleus is assumed; none of these appears in either the Glossary or the Index.

Other areas of psychopathology such as eating disorders, drug misuse, anxiety, mood disorders, and schizophrenia receive a similar level of attention in the succeeding chapters. Each chapter describes representative disorders and their diagnostic criteria, epidemiology, risk factors, biological and psychological theories of etiology, and empirically supported methods of assessment and treatment. These chapters are richly detailed, up-to-date, and carefully researched, and could serve as valuable resources for advanced undergraduates, graduate students, and practicing professionals. The concluding chapters survey in depth the most influential models of the etiology and treatment of disorders, and appraise the significant literature on the effectiveness of psychological therapy.

Carr acknowledges the different training emphases in other English-speaking countries such as Australia, Canada, South Africa, and the United States, and notes that there are well-developed doctoral training programs in clinical psychology in these countries as well. In some cases, he writes, earning a doctorate abroad might require one to complete additional training to conform to British and Irish standards. Carr completed his clinical psychology PhD in Canada, and had to take an additional placement before qualifying to work in the British National Health Service. In programs such as the one that he now directs in Ireland the academic coursework is limited to practice-focused material; there are no courses purely devoted to the traditional curricula of psychological science — perception, learning, and cognitive neuroscience, for example —possibly explaining his recommendation that clinical psychology program applicants prepare themselves by earning other graduate degrees first. But undergraduate psychology students in Britain follow an advanced curriculum leading to an honors degree, a curriculum that is almost entirely devoted to psychology courses. Traditionally, these courses seemed very similar to the graduate courses taken in American doctoral programs, at least from the perspective of a reviewer who, in the 1960s and 1970s, earned undergraduate and graduate degrees in Britain and an American PhD. A traditional British PhD program in psychological science requires no further courses; the sole basis for the degree is the doctoral dissertation, the product of intensive research supervised by a mentor. Coursework of the kind that Carr describes is specific to the clinical psychology graduate programs.

Those geographic and cultural differences notwithstanding, clinical psychology is presented in this book as a research-based enterprise undertaken by scientist–practitioners

who apply fundamental psychology in their work, a characterization that is likely to be congenial to Carr's North American colleagues. In that context, one of his statements jars somewhat. On the subject of taking advanced psychology degrees in order to increase one's chances of admission to a clinical program, he writes: "PhDs conducted in university laboratories with non-clinical participants or animals are not a useful preparation for clinical psychology training" (p. 15). The impressions given by this statement could be either that basic research is irrelevant to practice, or that clinicians apply the work of others rather than advancing the field themselves. But in the history of behavior therapy, for example, research in the animal laboratory settled some basic controversies about how to extinguish, or hasten the extinction of, conditioned fear (Baum, 1970; Wilson, 1973), with profound implications for practice. Hullian theory and clinical folklore had predicted that anxiety must be attenuated by a countervailing emotional state before a lasting response decrement could occur, but the work of Baum, Wilson, and others on response prevention in the extinction of avoidance behavior not only improved clinical outcomes for anxiety disorders such as obsessive–compulsive disorder but also spared clients from time-consuming, and unnecessary, procedures. Similar examples of basic research informing applied interventions abound from the 1970s to the present (e.g., O'Donohue and Fisher, 2009). It is true that clinical researchers have to confirm the applicability of such innovations to clients in mental health settings (e.g., Meyer, 1966; Brown, Stanley, and Bjorgvinsson, 2012), but such scientist–practitioners would hardly recommend their prospective clinical students avoid studying psychological science!

In recommending this book to psychology undergraduates in the English-speaking community the chief caveats would be the focus on training and practice in Ireland and the United Kingdom, and the limited — though scholarly and well-researched — coverage of psychopathology. The scope of the book will be viewed by some as a narrowly defined clinical psychology that excludes, for example, health psychology and forensic mental health applications; Carr classifies those areas as "related professions" and "other types of applied psychology" (p. 27). Yet this is nonetheless a valuable book that comfortably reaches its goal of providing an authoritative introduction to many aspects of clinical psychology for an advanced undergraduate readership.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of the mental disorders* (fourth edition, text revision, *DSM-IV-TR*). Washington, D.C., Author.

Baum, M. (1970). Extinction of avoidance responding through response prevention (flooding). *Psychological Bulletin, 74,* 276–284.

Brown, K.R., Stanley, M.A., and Bjorgvinsson, T. (2012). Obsessive–compulsive disorder. In V.S. Ramachandran (Ed.), *Encyclopedia of human behavior* (second edition, Volume 2, pp. 739–745). Oxford: Elsevier. http://dx.doi.org/10.1016/B978-0-12-375000-6.00260-3

Meyer, V. (1966). Modification of expectations in cases with obsessional rituals. *Behaviour Research and Therapy, 4,* 273-280.

O'Donohue, W.T., and Fisher, J.E. (Eds.). (2009). *General principles and empirically supported techniques of cognitive behavior therapy*. Hoboken, New Jersey: Wiley.

Wilson, G.T. (1973). Counterconditioning versus forced exposure in extinction of avoidance responding and conditioned fear in rats. *Journal of Comparative and Physiological Psychology, 82,* 105–114.

World Health Organization. (1992). *The ICD-10 classification of mental and behavioural disorders*. Geneva: Author.

A NOTE ON OUR BOOK REVIEW POLICY

We will accept book reviews for publication each issue. Authors wishing to submit book reviews are urged to write with the above interdisciplinary framework firmly in mind. All books *solicited* from publishers will be sent to selected individuals for review. JMB also accepts unsolicited reviews. Reviews should be absent of all titles except the name of the work reviewed, author of work reviewed, place of publication, publisher, date of latest publication, number of pages, and cost. Any individual wishing to submit a review should contact our Book Review Editor for further information: Steven E. Connelly, Ph.D., Department of English, Indiana State University, Terre Haute, Indiana 47809. Email: sconnelly@isugw.indstate.edu

JMB is abstracted or indexed in: *Cultures, Langues, Textes: La Revue de Sommaires; Current Contents (Social and Behavioral Sciences); EMBASE/Excerpta Medica; International Bibliography of Book Reviews; International Bibliography of Periodical Literature; Linguistics and Language Behavior Abstracts; Physics Abstracts; Psychiatric Rehabilitation Journal; PsychINFO/Psychological Abstracts; Research Alert; Social Science Citation Index; Social Work Abstracts; Sociological Abstracts; The Philosopher's Index.* The Journal of Mind and Behavior website is located at www.umaine.edu/jmb/.

The Journal of Mind and Behavior

Winter 2013 Vol. 34 No. 1

CONTENTS