Toward a Cognitive Neurobiological Account of Free Association

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Free association has been central to psychoanalytic theory and practice for over a century, yet its physiology has largely been ignored. When viewed from a cognitive neurobiological perspective, the process resembles a minimally constrained executive task, one that might engage the left dorsolateral prefrontal cortex. To test this hypothesis, we used functional magnetic resonance imaging to detect neural activity while subjects performed overt, vocal free association in the scanner. Twelve healthy subjects performed three active tasks—vocal free association, orthographic (letter) fluency, and semantic (category) fluency—alternating with a baseline condition, word repetition. Stimulus administration and overt response performance occurred during periods of scanner silence. Each subject was scanned three times, the order of conditions counterbalanced across scans. Statistical parametric mapping was used to perform a mixed-effects analysis of those images acquired. We found that, in common with both verbal fluency tasks, free association was accompanied by activation of the left dorsolateral prefrontal cortex. Indeed, it elicited significantly greater activation in adjacent areas. The main effect of "task," common to all three active conditions, revealed an extensive network of activation within executive brain regions (including bilateral dorsolateral prefrontal and anterior cingulate cortices). While free association has been considered a probe of the "unconscious," these data suggest that, early on in the process, under experiment conditions, this behavior engages components of the prefrontal executive (specifically, on the left). This finding points to a possible congruence between psychological accounts of "ego" function and neuropsychological accounts of a cognitive executive instantiated in prefrontal systems.

Keywords: prefrontal cortex; executive function; free association; ego; Freud; fMRI.

Introduction

> "I am persuaded that a day will come when the psychology of cognitive functions and psychoanalysis will have to fuse in a general theory which will improve both, through mutual correction, and starting right now we should be preparing for that prospect by showing the relation which could exist between them."
>
> Piaget (1973)

This article describes an attempt to examine the cognitive neurobiological basis of one of the most quintessentially psychoanalytic concepts and procedures, free association, using the techniques of contemporary cognitive neuroscience. While interpretations of the products of free association have formed the basis for many theoretical accounts of the mind (Kris, 1982; Mahony, 1979), there have been few attempts to instantiate the process within the brain. The following constitutes one step in this direction, advancing the project first proposed by Piaget (1973).

Free association has attracted various definitions, from the strictly procedural (what is done) to the interpretative (what is revealed):

> **Free association** . . . [is] an association freely made by the person undergoing [an experimental] test without suggestion or control on the part of the experimenter. [OED, 1989]

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Acknowledgments: We thank the subjects who participated in this study and Mrs. Jean Woodhead for assistance in manuscript preparation. CJKH received support from the MRC UK (a career establishment grant awarded to SAS); LC was supported by PPP; RDG was supported by Cephalon UK [through an investigator-led award to SAS]; and MDH was supported by a Wellcome Training Fellowship.

> [It] . . . involves allowing what comes to mind to be spoken, selecting nothing and omitting nothing, and giving up any critical attitude or direct forcing in the face of a problem. [Heaton, 2000]
>
> [It] draws on those freely wandering and undirected associative thoughts that constitute primary process thinking. [Andreasen et al., 1995]
>
> **Free association**. The patient's attempt to follow the so-called "fundamental rule" of spontaneously verbalizing whatever comes to mind in the psychoanalytic situation without selective editing or suppression of what is presumed to be irrelevant or important or is felt to be distressing. Freud believed that due to psychic determinism, free association would reveal unconscious repressed material. [EIEP, 2006]

The "fundamental rule" is that the patient must say what comes into her or his mind, "no matter how absurd, immoral, or painful it seem[s]" (Ellenberger, 1970). In Freud's terms, she must observe her own "unwilled thoughts" [*Einfälle*] and report honestly as these thoughts "freely intrude" into consciousness [*freier Einfall*] (Livingstone Smith, 2004). Such thoughts (and their vocal correlates) have been accorded particular authenticity, as if they expressed the "true self" (Bollas, 2002); hence, some pronouncements can seem rather extreme: "Tell me how you associate, and I will tell you who you are" (Spitzer, 1992). Galton, an early exponent of self-analysis (*avant la lettre*—before the term existed), stated that associations "lay bare the foundations of a man's thoughts with curious distinctness, and exhibit his mental anatomy with more vividness and truth than he would probably care to publish to the world" (Galton, 1879).

While the therapeutic application of free association may have had its antecedents in ancient Greek philosophical discourse and Jewish mysticism (Mahony, 1979), its modern explication probably begins with Freud, who may have first used the technique in 1888 during the treatment of Frau Emmy Von M. (Freud, 1895). Freud noted that she "was making use of our conversation, apparently unconstrained and guided by chance" (Freud, 1895). Nowadays, there remains an emphasis upon the patient's *unconstrained* generation of words with apparent spontaneity: words that are then subject to the therapist's (and/or client's) hermeneutic interpretation. Used in this way, free association has been said to manifest the "unconscious" (Bollas, 2002).

Clearly, associations acquired under such conditions (of spontaneity) do not produce a straightforward, linear narrative structure but something buffeted by transient cognitions: it is "a method for examining thinking processes that do not involve conscious organization of a sequential stream of events into a temporally linked account" (Andreasen et al., 1995). Hence, the procedure has something in common with those spontaneous forms of creativity encountered in the "action painting" of Jackson Pollock (Rosenberg, 1961; Schildkraut, Hirshfeld, & Murphy, 1994), the "free" music developing out of spontaneous improvisation (Jost, 1994; Watson, 2004; Wilmer, 1977), and the written experiments of some Surrealists (e.g., the various forms of the game "Exquisite Corpse" [*Le Cadavre exquis*]: Art Institute of Chicago, 1996; Ferrier & Le Pichon, 1999; Irwin, 1996). Indeed, this aspect of "freedom" is very much emphasized in one of the key texts on free association, where the purpose of the exercise is to "[expand] the patient's *freedom of association*." (Kris, 1982, p. 3, emphasis in original).

Therefore, to examine the cerebral processes underlying such a function we should not require subjects to rehearse or memorize narratives but, instead, to attempt "true" spontaneity.

However, the requirement that subjects generate a spontaneous stream of novel material, with little external specification, also invites an alternative conceptualization. For, from a cognitive perspective, free association resembles those verbal fluency tasks used clinically to probe the cognitive executive (Hodges, 1994). In these procedures, subjects are asked to generate responses from a specified category—for example, "words beginning with the letter F" (in orthographic, letter fluency) or "animals' names" (in semantic, category fluency)—within a specified time. Functional neuroimaging studies of healthy subjects have demonstrated left dorsolateral prefrontal cortex (DLPFC) activation during such tasks (Desmond, Gabrieli, & Glover, 1998; Frith, Friston, Liddle, & Frackowiak, 1991; Spence and Frith, 1999). Conversely, the absence of spontaneous speech, manifest as alogia in "functional" brain disorders (e.g., schizophrenia and depression), has been shown to be associated with hypometabolism of left DLPFC (Dolan et al., 1993); also, structural lesions in this location have precipitated "dynamic" or "transcortical motor" aphasia, characterized by an inability to generate spontaneous speech (especially under unconstrained conditions), while the ability to repeat that of others is preserved (Freedman, Alexander, & Naeser, 1984; Lichteim, 1885; Warren, Warren, Fox, & Warrington, 2003).

Hence, one might ask: is free association *actually* a manifestation of a functioning prefrontal cognitive executive (implicating especially the left DLPFC), in a way similar to verbal fluency? Crucially, under each of these conditions subjects are allowed an element of choice over what they are to say. For instance, in orthographic fluency they may say almost any word beginning with the letter "F," in any sequence. Thus, their responses are not entirely constrained by the examiner, although, some constraints do apply (the restriction to "F" words, the exclusion of proper nouns, the avoidance of repetitions, etc.). In free association the subject also has a choice over which words may be spoken, but that choice is considerably less constrained. The freely associating subject may say literally any word and still be "correct" (barring hermeneutic considerations or questions of authenticity). Hence, from a purely cognitive perspective, free association resembles an executive task in that the subject must make choices (he or she cannot rely solely on the therapist for guidance).

Now, of course, these comments refer to single-word associations, as might apply in clinical tests of verbal fluency; however, the same considerations might also apply to unconstrained discourse, the patient speaking freely in sentences, at greater length. Narrative discourse has also been associated with activation of distributed prefrontal systems (e.g., Blanke, Scott, Murphy, Warburton, & Wise, 2002).

Such a way of conceptualizing free association, as a cognitive process, is also congruent with an earlier, German literature reviewed by Spitzer (1992). At the turn of the nineteenth/twentieth centuries, several authors used behavioral techniques to study the verbal associations of healthy volunteers and people with dementia praecox (schizophrenia). While Kraepelin noted that verbal associations became more stereotypic following alcohol consumption, and Aschaffenburg described the same deterioration following fatigue, Jung noted that during distraction the subject's responses became more "habitual": "if attention decreases, associations become increasingly superficial, i.e., their value decreases" (quoted in Spitzer, 1992). These authors also investigated the relationship between the salience of associations and their response times (RTs), so that more superficial associations (e.g., those based solely on the sound of a word) were associated with shorter RTs (Spitzer, 1992). Conversely, in the forensic setting, longer RTs, in response to significant material, were thought to imply guilt (Jung, 1935). (Indeed, Freud also noted that the "most important sign" of a connection between two thoughts was the length of a patient's hesitation between them—Freud, 1906.) These authors' use of RTs, and their emphasis upon the stereotypic or elaborated nature of associations, elicited under different conditions, suggests that there was inherent in their work a recognition that routine or stereotypic associations require less "processing" (and hence shorter RTs) for their production, while more complex associations (e.g., those subject to deliberate suppression or unconscious "resistance") evince longer RTs. This resembles a cognitive understanding of such processes. Indeed, Spitzer (1992) concluded that "the experimental work done by Kraepelin and his coworkers represents an example of how excellent work can be forgotten because it is too advanced for a given time."

Given all of the above, we wished to return to the issue of whether free association might be understood in cognitive terms and whether it might be scientifically investigated using modern functional neuroimaging techniques. To do this we had to place certain specified constraints upon the process, and these are important to acknowledge at the outset. Though our subjects could say whatever came into their minds, they were asked to do so using only one word at a time, and at a fixed pace, so that their freely associated utterances might be "matched" against certain control conditions that also involved word generation. Hence, although our subjects were free to say "what" they wanted, they were not entirely free to speak "when" they wanted. Therefore, in the rest of the article we distinguish what we are studying here, "vocal free association," from that process occurring in a psychotherapeutic setting, "free association."

Method

We studied 12 right-handed (Oldfield, 1971), native English-speaking males. None had a significant medical or psychiatric history. Subjects were aged 20–42 years (mean age of 26.1, $SD = \pm 6.5$) and had received 15–18 years' education. Their predicted verbal IQs (Nelson & O'Connell, 1978) ranged between 98 and 121 (mean 111.4, $SD = \pm 7.2$). Hence, they possessed some of the features of those who might be accepted for psychotherapy (Clare, 1993). All subjects provided written informed consent. The study was approved by the local Research Ethics Committee.

Data acquisition

Subjects underwent whole head fMRI scans in a 1.5 Tesla system (Eclipse, Philips Medical Systems, Cleveland, Ohio) at the University of Sheffield. Gradient-recalled echo-planar imaging (EPI) was carried out over 72 time points, in which 27 × 4-mm transverse slices were acquired: echo time (TE) = 50 ms; acquisition time (TA) = 3 s; repetition time (TR) = 6 s; field of view (FOV) = 240 mm; in-plane matrix = 128 × 128).

Three fMRI scan series (runs) were acquired for each subject, each lasting 432 s (comprising 6 × 72-s epochs). During each run, an alternating A/B blocked design was used to delineate the baseline condition (A) and active conditions (B) (Figure1) where each A/B pair comprised a 72-s epoch.

Each condition (A or B) comprised six × 6-s TR units consisting of a 3-s silent period, during which a stimulus prompt was delivered and the subject's vocal response made, interleaved with a 3-s acquisition period, during which one set of anatomical echo-planar (EP) images of the latent blood oxygen level-dependent (BOLD) response was obtained (Figure 1). Hence, stimuli and responses occurred during periods of scanner silence (the "sparse" technique; Hall et al., 1999).

Each condition required the subject to vocalize words in response to an audible stimulus, "Now," according to the specified task: to produce words beginning with a given letter during orthographic fluency (OF), words belonging to a specified category during semantic fluency (SF), and words that came to mind freely during vocal free association (VFA). The baseline task required the subject to repeat the word "now" when instructed.

An instruction as to which of these tasks should be performed was given at the start of each condition (Figure 1). Each active task was performed twice in each run according to a counterbalanced design. In order to avoid behavioral or hemodynamic response artifacts resulting from a predictable task sequence, each run comprised a counterbalanced sequence of tasks, where the last three active tasks in each run comprised a mirror image of the first three (i.e., ABCCBA, BCAACB and CABBAC) (Figure 2).

Orthographic and semantic category prompts were obtained from the standardized D-KEFS Verbal Fluency Test, (Delis, Kaplan, & Kaplan, 2001) and calibrated for equivalence. Because each active task was performed a total of six times over the three runs, the regular and alternate forms of these tests were used to provide six different subconditions. Orthographic and semantic categories were split across the runs so that priming effects due to semantically similar categories would be minimized and runs evenly matched for difficulty (Figure 2). All responses were recorded onto audiotape during the scanning procedure.

Individual and group analyses were carried out using statistical parametric mapping in SPM2

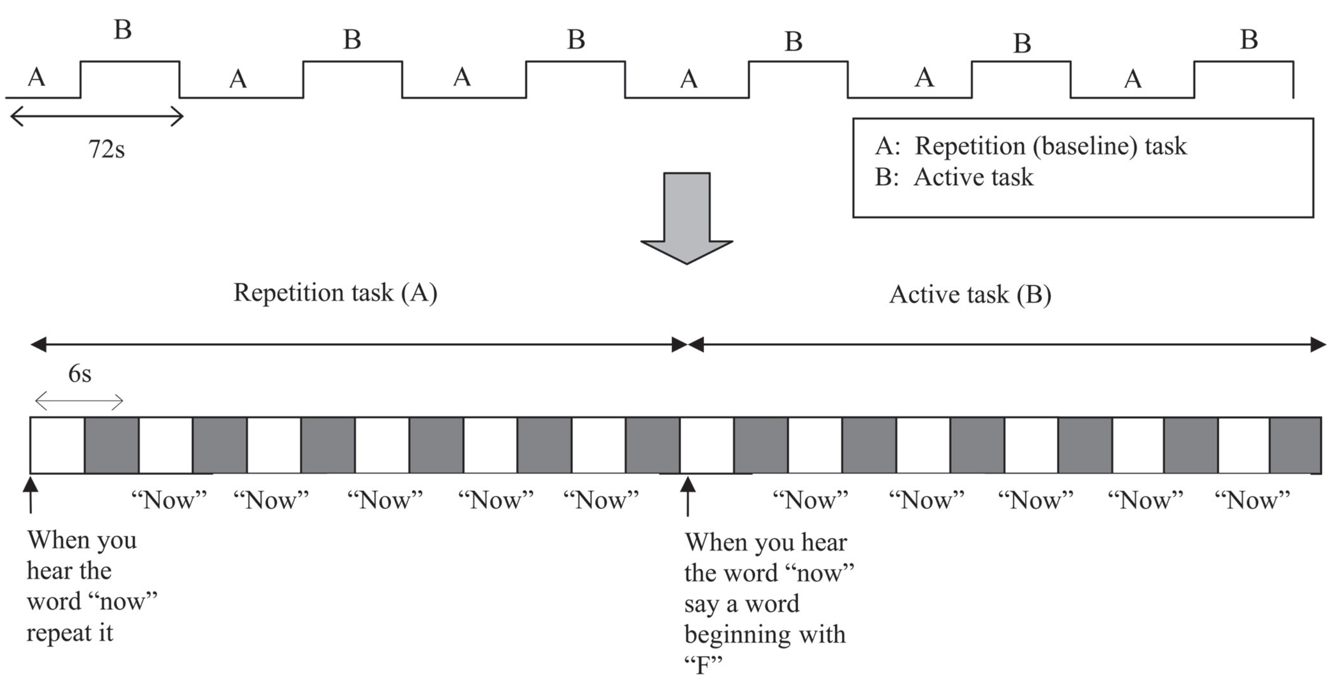

Figure 1. Scanning paradigm. Baseline and active conditions (orthographic and semantic fluency and vocal free association) applied in an alternating block design, with each A/B block lasting 72 s. Each of the three scan runs comprised six epochs.

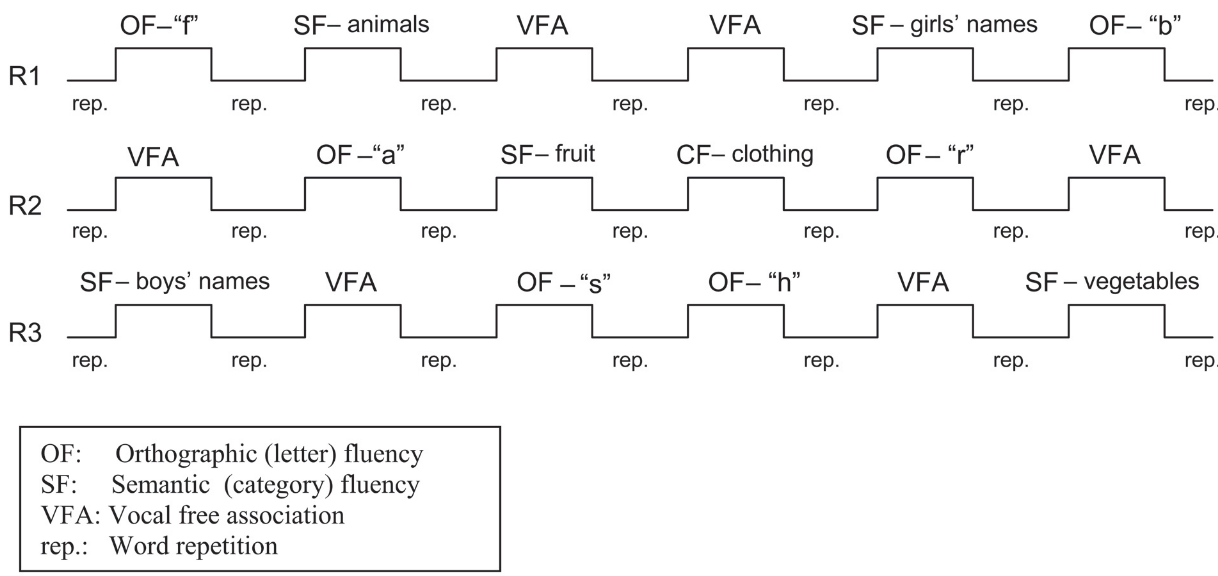

Figure 2. Boxcar design of the scanning paradigm. Each subject underwent three functional runs (R1–R3) during which the order of active conditions was counterbalanced.

(www.fil.ion.ucl.ac.uk/spm/software/spm2) (Friston, Holmes, Worsley, & Poline, 1995) run on a Matlab v6 platform (The MathWorks Inc.). All images were preprocessed to correct for slice timing, alignment, and head movement. Brain volumes were then normalized to the stereotactic space utilized by SPM2 (Montreal Neurological Institute, MNI, template) and smoothed using a Gaussian kernel of 6-mm full width half maximum (FWHM). SPM2 combines Gaussian field theory with the general linear model to allow statistical inferences to be drawn regarding deviations from the null hypothesis in three-dimensional brain space (Friston et al., 1995).

Data analysis

At the individual subject level, a matrix was designed to include all three scans, according to the basic boxcar model. All permutations of active condition versus baseline or another active condition were modeled. This approach produced single-subject contrast images for each effect-of-interest, in stereotactic space, according to the MNI template (Evans et al., 1993).

Individual subjects' contrast images were then used in the second-level (group) analyses detailed below. Hence, our group statistical model was of "mixed-effects," with between-subject variance treated as a random effect, allowing inferences to be derived regarding the population from which the subjects were drawn (Friston, Holmes, & Worsley, 1999).

The pivotal analyses in this study were those involving VFA, compared with baseline and other active conditions, and also the main effect of "task" minus baseline, which revealed areas activated irrespective of the specific active condition (i.e., those areas common to all the "fluencies").

Hence, the primary hypotheses and analyses were as follows:

1. Active conditions minus baseline: we hypothesized that each active condition (VFA, OF, SF) would activate left DLPFC relative to baseline (word repetition).
2. Activations specific to VFA: we hypothesized that VFA, a less constrained executive task, would elicit greater left prefrontal activation than OF and SF.
3. Main effect of "task" minus baseline: we hypothesized that certain regions within the prefrontal executive (primarily left DLPFC) would be activated irrespective of the specific active condition (VFA, OF, or SF).

For each group analysis (above), the relevant individual contrast images were entered in a second-level one-sample *t* test (the mixed-effects model). Clearly, there were many potential analyses, but we have restricted our report to those of direct relevance to our hypotheses: contrasts between active conditions and baseline (Hypothesis 1), between VFA and other active conditions (Hypothesis 2), and the main effect of all active conditions against baseline (across each functional imaging run; Hypothesis 3).

As these analyses were hypothesis-driven (with respect to left prefrontal cortex, above) all contrasts were uncorrected for height of activation, $p < .001$, with extent > 40 voxels, with the exception of the third analysis where, in view of the enhanced power of our combined analysis, a higher threshold was adopted ($p < .05$, family-wise error corrected) in order to constrain significant foci. Coordinates of foci within the MNI stereotactic space were subsequently transposed into Talairach and Tournoux (1988) coordinates for neuroanatomical identification and labeling.

Results

Behavioral data

All subjects performed the task satisfactorily, and 94.5% (1,020 out of a total of 1,080) of their vocal responses were clearly audible (and recorded on to tape) during the procedure. Our experimental design elicited relatively short sequences of vocal free association (i.e., 5 words during each of the 6 sequences). Although not formally analyzed, these were of some phenomenological interest, ranging from the highly structured through to those with clear confluence of themes, and some that were perhaps more emotive—for example, "heart, surgeon, theatre, operation, gown"; "over, cricket, bat, Dracula, demon"; and "breathe, freedom, still, calm, laughing."

Imaging data

Hypothesis 1

Vocal free association versus baseline. With respect to our first hypothesis, that VFA would activate left DLPFC, our data reveal widespread activation of this and of other frontal executive regions (in comparison with word repetition) (Table 1, Figure 3). There are significant activations throughout bilateral prefrontal cortices and salient subcortical foci (including thalamus and cerebellum).

Orthographic letter fluency versus baseline. Orthographic fluency also activated left prefrontal cortex (as predicted) (Table 2; Figure 3). Again, relative activation occurred within thalamic and cerebellar foci.

Semantic category fluency versus baseline. Semantic fluency elicited activation of predominantly left frontal regions, left caudate, and thalamus (Table 3; Figure 3).

Hypothesis 2

Vocal free association (versus baseline) versus other active conditions (versus baseline). Visual inspection of Figure 3 suggests that at a qualitative level, and in accordance with our second hypothesis, there is greater left prefrontal activation during VFA than either of the other active conditions (compared with baseline, word repetition). Formal comparison, utilizing a random-effects analysis confirmed that this was localized to two left frontal foci (Table 4).

Hypothesis 3

Main effect of all active conditions versus baseline. Our combined analysis of all the active word-generation conditions (VFA, OF, and SF), versus baseline, revealed a pattern of shared foci that was statistically highly significant (Figure 4). As might be expected from the foregoing analyses, these activations implicated left prefrontal regions in particular, although there were also foci in right prefrontal cortex and pertinent temporal and subcortical regions (Table 5).

Discussion

Free association has formed one of the basic components of psychoanalytic technique for over a century and has been regarded as a probe of the psychodynamic "unconscious." However, when viewed from a cognitive perspective, it resembles an executive task, requiring subjects to generate a novel sequence of actions (words) in the relative absence of external constraint. We hypothesized that, under experimental conditions, a variant of such a task, vocal free association, would activate the prefrontal, cognitive executive, specifically in the region of left DLPFC, and we tested this hypothesis in healthy subjects using fMRI. Our findings confirm our hypotheses, namely: VFA is associated with activation of the left DLPFC (and other prefrontal regions); such activation is more extensive than that seen during other word-generation tasks (extending anteriorly and inferiorly, into Brodmann Areas 10 and 44, respectively); although, as demonstrated by our final combined analysis, the functional anatomies of these three tasks share much in common (e.g., all activate left DLPFC). All in all, our data suggest that VFA does indeed elicit activation within the prefrontal

Table 1. Brain regions exhibiting greater BOLD response during vocal free association compared with baseline, word repetition

Region	*BA*	*Talairach coordinates*	*Z value*
Left anterior prefrontal	10	–32, 57, 14	5.10
Left dorsolateral prefrontal	9	–48, 15, 27	4.82
Left inferior frontal	9	–32, 50, 27	4.61
Left premotor	45	–55, 28, 6	4.50
	6	–40, 6, 46	4.63
Left medial prefrontal	8	–8, 43, 38	5.31
Right anterior cingulate	32	10, 19, 32	5.12
Medial premotor	6	2, 11, 57	4.87
Right prefrontal	10/46	40, 45, 5	4.05
	10	38, 40, 13	3.56
Right inferior frontal	47	34, 21, –10	4.84
Right superior temporal	38	44, 17, –20	4.07
Left middle temporal	21	–42, –18, –13	5.09
		–54, –24, –7	5.00
Right middle temporal	21	50, –22, –11	4.90
		48, –39, –1	4.87
Left superior parietal	7	–26, –46, 48	4.46
Left occipital	19	–16, –88, 36	4.02
Right occipital	18	20, –103, 5	4.85
Left striatum		–12, 2, 2	5.69
Right putamen		16, 12, –2	4.61
Thalamus		2, –13, 6	4.40
Left cerebellum		–20, –59, –16	5.24
		–14, –71, –12	4.61

*Only the most significant focus for each cluster is reported.

Note: Mixed-effects analysis, significance threshold $p < .001$, uncorrected. We have not attributed laterality to maxima occurring within FWHM of the midline. BA = Brodmann area.

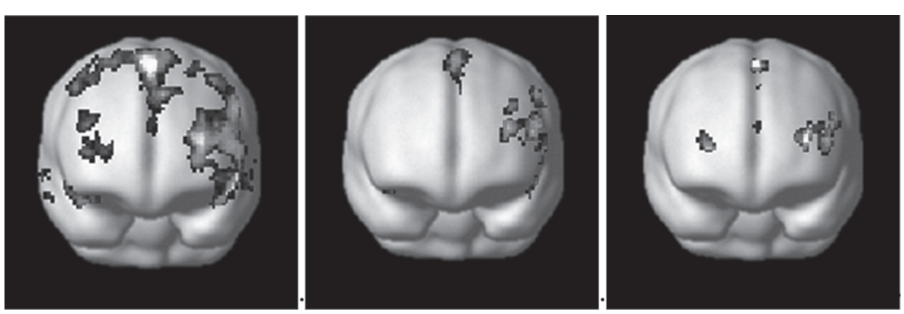

Figure 3. Frontal views of brain regions exhibiting greater neural response during active conditions than during word repetition (left to right: VFA, OF, and SF) ($p = .001$ uncorrected, extent = 40).

Table 2. Brain regions exhibiting greater BOLD response during orthographic, letter fluency compared with baseline, word repetition

Region	*BA*	*Talairach coordinates**	*Z value*
Left anterior prefrontal	10	–34, 48, 20	4.45
Left inferior frontal	44	–39, 7, 25	4.95
Left dorsolateral prefrontal	46	–38, 22, 23	4.26
	45	–52, 17, 21	4.25
Left inferior frontal	45	–55, 28, 6	4.27
Medial premotor	6	2, 10, 53	4.65
Left premotor	6	–8, 12, 51	4.53
Anterior cingulate	32	4, 21, 40	4.37
Right inferior frontal	47	36, 25,–6	4.28
Left middle temporal	21	–46, –41, –8	4.67
Right middle temporal	21	52, –32, –14	4.21
Thalamus		0, –2, 4	4.02
Right cerebellum		8, –30, –14	4.58
Cerebellar vermis		0, –47, –13	4.38

*Only the most significant focus for each cluster is reported.

Note: Mixed-effects analysis, significance threshold $p < .001$, uncorrected. We have not attributed laterality to maxima occurring within FWHM of the midline.

Table 3. Brain regions exhibiting greater BOLD response during semantic, category fluency compared with baseline, word repetition

Region	*BA*	*Talairach coordinates**	*Z value*
Left anterior prefrontal	10	–32, 49, 10	4.18
Left inferior frontal	45	–40, 22, 19	4.68
Left anterior cingulate	32	–6, 16, 42	4.79
Left premotor	32/9	–10, 38, 20	4.50
	6	–8, 14, 53	4.39
Right prefrontal	10	30, 53, 8	3.80
Left caudate		–16, 14, 20	4.76
Thalamus		0, –13, 8	4.13

*Only the most significant focus for each cluster is reported.

Note: Mixed-effects analysis, significance threshold $p < .001$, uncorrected. We have not attributed laterality to maxima occurring within FWHM of the midline.

Table 4. Frontal brain regions exhibiting greater BOLD response during vocal free association (minus baseline) compared with orthographic and semantic fluencies (minus baseline)

Region	*BA*	*Talairach coordinates**	*Z value*
Left anterior prefrontal	10	–18, 53, 1	4.31
Left inferior frontal	44	–56, 14, 16	4.4

*Only the most significant focus for each cluster is reported.
Note: Mixed-effects analysis, significance threshold $p < .001$, uncorrected.

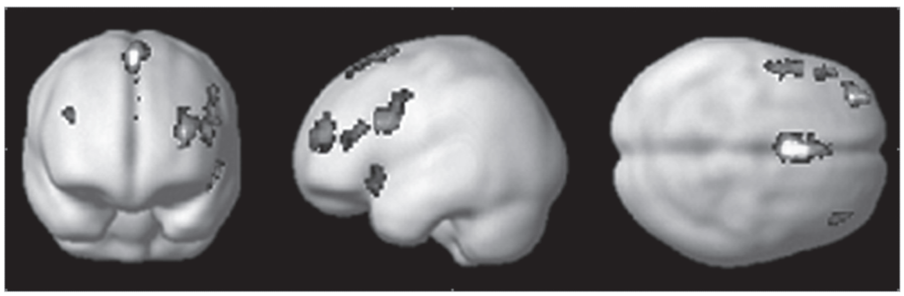

Figure 4. Brain regions activated in common across all active word-generation conditions (relative to word repetition), viewed from front, left, and above (family-wise error, FWE) ($p = .05$, extent = 40).

Table 5. Brain regions exhibiting greater BOLD response during the internal generation of words (vocal free association, orthographic letter and semantic fluency) compared with baseline, word repetition

Region	*BA*	*Talairach coordinates**	*Z value*
Left anterior prefrontal	10	–32, 57, 14	6.83
Left dorsolateral prefrontal	46	–48, 30, 17	5.85
Left inferior frontal	44	–48, 12, 25	6.77
Anterior cingulate	32	–2, 17, 38	7.55
Medial premotor	6	0, 11, 57	7.51
Right anterior prefrontal	10/9	40, 46, 22	5.71
Left superior temporal	38	–52, 19, –11	6.32
Left caudate		–18, 9, 18	6.75
Right caudate		20, 1, 22	6.62
Thalamus		0, –11, 12	6.57
Cerebellum		–2, –78, –10	5.69

*Only the most significant focus for each cluster is reported.
Note: Mixed-effects analysis, family-wise error = 0.05, corrected. We have not attributed laterality to maxima occurring within FWHM of the midline.

executive. Nevertheless, a question remains: to what extent is "our" VFA protocol a "good-enough" proxy for that form of free association occurring in the therapeutic environment?

Our model has obvious weaknesses. One is the relatively brief nature of our experimental procedure, lasting a little over 21 minutes in total. Therefore, we have to remain circumspect with regard to the functional anatomy of a *therapeutic* free association that is repeated over longer durations (although this might be addressed through further empirical studies). Similarly, the experimental nature of our study and its setting, it might be argued, detract from its validity, not least since the scanning environment itself is so different from that pertaining in the psychotherapeutic encounter. The MR scanner is an unusual environment, the subject lying in a relatively confined space, isolated from the observers. It is intermittently noisy, although our acquisition technique allowed us to acquire data generated during periods of silence. Nevertheless, there is at least one feature of our technique which is not unlike that encountered in traditional psychoanalysis: in the latter, the patient lies on a couch and does not have eye contact with the analyst; the patient cannot see the expressions of his or her interlocutor. So in this regard our protocol is not so different from that encountered therapeutically. Indeed, the relative isolation of the subject within the scanner bore favors their focusing on internal processes without the distraction of eye contact.

Nevertheless, it might be argued that our technique places too much emphasis on spontaneity and the utterance of single words, rather than on the narrative sentences that might be expected in analytic, or other, psychotherapeutic settings. Here, again, there is room for debate. As stressed by Andreasen and colleagues (1995) the purpose of therapeutic free association is to access "primary process" thinking, which is necessarily disjointed (and not a straightforward, linear narrative). We specifically wished our subjects to truthfully reflect spontaneous thoughts via the words they generated, so recourse to narratives might have diverted us from the relevant processes. Furthermore, there are certain analytic perspectives (e.g., the Lacanian) that privilege the freely emerging genesis of pure verbiage, without formal structure, "foreclosed from the ego's reality" (Thurston, 2004), so, pure language without structure may be accorded special status within certain psychoanalytic literatures.

With respect to the words that our subjects spoke, there is a further caveat, albeit shared with (early) therapeutic free association: the possibility that subjects selected from those words arising in their minds [*freier Einfall*], exercised internal censorship, and suppressed certain responses that might have caused embarrassment. Certainly, some subjects seemed to generate potentially sexual material—for example, "pink, feather, bird, pole, dance"—which is consistent with other (phenomenological) studies of free association (e.g., that of Winck, 1962, described by Mahony, 1979). We have no direct evidence of self-censorship although, again, if it occurred, it suggests a resemblance between our protocol and that elicited early on in a therapeutic context by free association, while the subject is still relatively guarded, or inhibited, with respect to what he or she may say before others. Indeed, while our technique has the relative advantage of isolating the subject from eye contact with others, the subject does know that she or he is being heard. Hence, there is some potential for the "ego" to "manage" those utterances that emerge, reconciling "honest" primary-process thinking with the reality (expedients) of a social context.

Despite these caveats, our study offers an insight into the cognitive neurobiological architecture that is "required" to support free association in the human brain. As expected, the data serve to emphasize the role of the left dorsolateral prefrontal cortex in generating what is essentially a sequence of "internally generated" actions in the relative absence of external constraint (Frith et al., 1991). With this in mind, it is of interest to consider *why* left prefrontal cortex features so prominently among those areas where our construct of VFA evokes *greater* activation than do orthographic and semantic fluencies. Although all these conditions have much in common, they differ in one crucial respect: the likely size of the permissible response set. When a subject is called upon to generate words beginning with the letter "F," or animals' names, there is a finite, accessible set size that may become readily apparent (e.g., in 1 minute a healthy subject may generate 10–20 words in either category) (Hodges, 1994). However, the set of words permitted during VFA is far larger; it is potentially as great as the subject's lexicon. Hence, to constrain their responses, to order their "response space" (Frith, 2000), during VFA may require more from our subjects' prefrontal executive. This conjecture also finds support in previous studies that have described a relationship between the magnitude of left DLPFC activation and that of the set size of potential verbal responses, under more constrained conditions (e.g., Desmond, Gabrieli, & Glover, 1998; Nathaniel-James & Frith, 2002). Furthermore, recent work from our laboratory and others has demonstrated the key role of left prefrontal cortex in modulating "response space," under conditions where the subject must order or control his or her responses in time (Ganesan, Green, Hunter, Wilkinson, & Spence, 2005; Hunter, Green, Wilkinson, & Spence, 2004). Thus, the specific requirements of experimental VFA—that the subject choose his or her utterance from among a very large response set (of permitted, potential responses)—may explain the preferential engagement of left prefrontal cortices during this task. However, we should reiterate that there is much overlap between the cognitive architectures of all our "active" conditions. Hence, while left prefrontal cortex is markedly activated during VFA, other executive regions (activated during other forms of fluency) are also contributory.

Finally, it is perhaps worth considering how our findings might impact psychoanalytic theory, specifically that pertaining to the *very beginning* of the therapeutic free-association process. The classic psychoanalytic literature from Freud onwards (but also the empirical literature, exemplified by Galton, 1879, and those authors reviewed by Spitzer, 1992) has emphasized the authenticity of words uttered freely (as discussed above). Authors have argued for free association's privileged access to some inner, truer "self." Notwithstanding the problems associated with the concept of a unitary self, especially in light of postmodernism (Thurston, 2004), it is of interest to consider whether the psychodynamic "self" has anything in common with the prefrontal cognitive executive. Even in Freud's writings there is an emphasis on the control of behavior and the notion that, in some way, truthfulness emerges when responses elude supervisory (or executive) control. Hence, when considering free association, Freud posits that relaxation leads to the emergence of unconscious material: "What happens is that, with the relaxation of the inhibiting attention—in still plainer terms, *as a result of* this relaxation—the uninhibited stream of associations comes into action" (Freud, 1895).

Similarly, when considering slips of the tongue, and what they may reveal, he seems to invoke an executive, which may be called upon to prevent disclosure: "I really do not think that anyone would make a slip of the tongue in an audience with his Sovereign, in a serious declaration of love or in defending his honor and name before a jury—in short, on all those occasions in which a person is heart and soul engaged" (Freud, 1895).

Hence, it seems as if there is inherent in Freud's writing an understanding that the executive system must be *bypassed* for the unconscious to emerge, and that the latter will not happen when one is "heart and soul engaged." Now, if we substitute the word "ego" for the word "executive," then we might posit that what our VFA protocol *really* addresses is the *early* phase of free association, when factors such as control, editing, and resistance exert their influences on what the subject says (explicitly). If this were so then we might expect such self-censorship to *decrease* during the course of repeated free association, in effect the "ego/executive" exerting less "resistance" to our subject's "freedom of association" (Kris, 1982). Hence, we have a hypothesis that is tractable through further empirical work: that continued practice of free association will lead to *less* executive activation over successive epochs.

Note also, that this brings us to an interesting, apparent convergence between disparate psychological "schools." What the early German authors, reviewed by Spitzer (1992), valued most about the associative process occurred during that phase when the responses generated were more diverse (when response times were longer) and less stereotypic (whereupon response times became shorter). Alcohol and fatigue rendered such associations more predictable (more "superficial", but also perhaps more "truthful": *in vino veritas*). Now, when free association was deployed in the forensic setting, both Jung and Freud attributed *greater* significance to those responses that were delayed (i.e., when response times were longer) and hence were more purposeful (Freud 1906; Jung, 1935). Again, the putative significance concerned what was concealed: it was longer response times and the exertion of control (resistance) that implied reduced veracity. Furthermore, this is consistent with later deception literatures (e.g., see Spence et al., 2004): lying is associated with longer response times and greater prefrontal activation, truthfulness the opposite. So, if we transpose these considerations to our current findings, we may hypothesize that it is precisely the prefrontal executive that "should be" implicated during the early phase of free association, during resistance. A freely associating, uninhibited subject might be posited to exhibit less extensive prefrontal activation than one who is "inhibiting" and "trying" to control what she or he says.

This poses something of a question for psychoanalytic theory—is it the more purposeful (more guarded, and potentially less "honest") material that emerges early on in an analysis that is most significant, or is it that which emerges later on in the process (which, by inference, may be more stereotypic, yet more "truthful")? Of course, these might be interpreted as opposite sides of the same coin: the "truth" that compels the executive to limit disclosure may be the same truth that emerges when the executive is distracted or "relaxed." Such a manifestation of executive processes can also be discerned in the motor behaviors performed in conversion disorder (Spence, 1999), and it is implicated in modern accounts of vocal deception (e.g., Spence, Kaylor-Hughes, Farrow, & Wilkinson, 2008). In each of these settings, it is the engagement of the cognitive executive that seems pivotal to the balance between withholding and releasing information (behaviorally or verbally). We hope that further empirical studies may take these investigations forward.

REFERENCES

Andreasen, N. C., O'Leary, D. S., Cizadlo T., Arndt S., Rezai K., Watkins L., et al. (1995). Remembering the past: Two facets of episodic memory explored with positron emission tomography. *American Journal of Psychiatry,* 152: 1576–1585.

Art Institute of Chicago (1996). *Mary Reynolds and the Spirit of Surrealism*. Chicago: Art Institute of Chicago (Museum Studies, Vol. 22, 145).

Blanke, S. C., Scott, S. K., Murphy, K., Warburton, E., & Wise, R. J. S. (2002). Speech production: Wernicke, Broca and beyond. *Brain*, 125: 1829–1838.

Bollas, C. (2002). *Free Association*. Cambridge: Icon Books.

Clare, A. W. (1993). Interpretative psychotherapies. In: R. E. Kendall & A. K. Zealley (Eds.), *Companion to Psychiatric Studies* (5th edition). Edinburgh: Churchill Livingstone, pp. 879–897.

Delis, D. C., Kaplan, E., & Kaplan, E. (2001). *Technical Manual: D-KEFS Executive Function System*. San Antonio, TX: The Psychological Corporation.

Desmond, J. E., Gabrieli, J. D., & Glover, G. H. (1998). Dissociation of frontal and cerebellar activity in a cognitive task: Evidence for a distinction between selection and search. *NeuroImage*, 7: 368–376.

Dolan, R. J., Bench, C. J., Liddle, P. F., Friston, K. J., Frith, C. D., Grasby, P. M., et al. (1993). Dorsolateral prefrontal cortex dysfunction in the major psychoses: Symptom or disease specificity? *Journal of Neurology, Neurosurgery & Psychiatry*, 56: 1290–1294.

EIEP (2006). *Edinburgh International Encyclopedia of Psychoanalysis*. Edinburgh: Edinburgh University Press.

Ellenberger, H. F. (1970). *The Discovery of the Unconscious: The History and Evolution of Dynamic Psychiatry*. London: Fontana Press.

Evans, A. C., Collins, D. L., Mills, S. R., Brown, R. D., Kelly, R. L., & Peters, T. M. (1993). 3D statistical neuroanatomical models from 305 MRI volumes. *Nuclear Science Symposium and Medical Imaging Conference, 1993. IEEE Conference Record,* 108: 1877–1878.

Ferrier, J. L., & Le Pichon, Y. (1999). *Art of the 20th Century: A Year-by-Year Chronicle of Painting, Architecture, and Sculpture*, trans. W. D. Glanze & L. Davidson. Turin: Chene-Hachette.

Freedman, M., Alexander, M. P., & Naeser, M. A. (1984). Anatomical basis of transcortical motor aphasia. *Neurology*, 34: 409–417.

Freud, S. (1895) (with Breuer, J.). *Studies on Hysteria*. *Standard Edition,* 2.

Freud, S. (1906). Psycho-analysis and the establishment of the facts in legal proceedings. *Standard Edition*, 9: 103–114.

Friston, K. J., Holmes, A. P., & Worsley, K. J. (1999). How many subjects constitute a study? *NeuroImage,* 10: 1–5.

Friston, K. J., Holmes, A. P., Worsley, K. J., & Poline, J. P. (1995). Statistical parametric maps in functional imaging: a general linear approach. *Human Brain. Mapping*, 2: 189–210.

Frith, C. D. (2000). The role of dorsolateral prefrontal cortex in the selection of action, as revealed by functional imaging. In: S. Monsell & J. Driver (Eds.), *Control of Cognitive Processes: Attention and Performance XVII*. Cambridge, MA: MIT Press.

Frith, C. D., Friston, K., Liddle, P. F., & Frackowiak, R. S. J. (1991). A PET study of word finding. *Neuropsychologia*, 29: 1137–1148.

Galton, F. (1879). Psychometric experiments. *Brain,* 2: 149–162.

Ganesan, V., Green, R. D., Hunter, M. D., Wilkinson, I. D., & Spence, S. A. (2005). Expanding the response space in chronic schizophrenia: The relevance of left prefrontal cortex. *NeuroImage*, 25: 952–957.

Hall, D. A., Haggard, M. P., Akeroyd, M. A., Palmer, A. R., Summerfield, A. Q., Elliott M. R., et al. (1999). "Sparse" temporal sampling in auditory fMRI. *Human Brain. Mapping*, 7: 213–223.

Heaton, J. M. (2000). *Wittgenstein and Psychoanalysis*. Cambridge: Icon Books.

Hodges, J. R. (1994). *Cognitive Assessment for Clinicians*. Oxford: Oxford University Press.

Hunter, M. D., Green, R. D. J., Wilkinson, I. D., & Spence, S. A. (2004). Spatial and temporal dissociation in prefrontal cortex during action execution. *NeuroImage*, 23: 1186–1191.

Irwin, R. (1996). *Exquisite Corpse*. London: Vintage.

Jost, E. (1994). *Free Jazz.* New York: Da Capo Press.

Jung, C. G. (1935). Tavistock Lecture II. In: *Jung: Selected Writings*, ed. A. Storr. London: Fontana, 1986.

Kris, A. O. (1982). *Free Association: Method and Process* (revised edition). London: Karnac, 1996.

Lichteim, L. (1885). On aphasia. *Brain*, 7: 433–484.

Livingstone Smith, D. (2004). *Why We Lie: The Evolutionary Roots of Deception and the Unconscious Mind*. New York: St Martin's Press.

Mahony, P. (1979). The boundaries of free association. *Psychoanalysis and Contemporary Thought*, 2: 151–198.

Nathaniel-James, D. A., & Frith, C. D. (2002). The role of the dorsolateral prefrontal cortex: Evidence from the effects of contextual constraint in a sentence completion task. *NeuroImage*, 16: 1094–1102.

Nelson, H. E., & O'Connell, A. (1978). Dementia: The estimation of premorbid intelligence levels using the National Adult Reading Test. *Cortex*, 14: 234–244.

Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh Inventory. *Neuropsychologia*, 9; 97–113.

OED (1989). *Oxford English Dictionary* (2nd edition). Oxford: Oxford University Press.

Piaget, J. (1973). The affective unconscious and the cognitive unconscious. *Journal of the American Psychoanalytic Association*, 21: 249–261.

Rosenberg, H. (1961). The American action painters. *The London Magazine*, 1 (4): 45–56.
Schildkraut, J. J., Hirshfeld, A. J., & Murphy, J. M. (1994). Mind and mood in modern art, II: Depressive disorders, spirituality, and early deaths in the abstract expressionist artists of the New York School. *American Journal of Psychiatry*, 151: 482–488.
Spence, S. A. (1999). Hysterical paralyses as disorders of action. *Cognitive Neuropsychiatry,* 4: 203–226.
Spence, S. A., Farrow, T. F. D., Herford, A. E., Wilkinson, I. D., Zheng, Y., & Woodruff, P. W. R. (2001). Behavioural and functional anatomical correlates of deception in humans. *Neuroreport*, 12: 2849–2853.
Spence, S. A., & Frith, C. D. (1999). Towards a functional anatomy of volition. *Journal of Consciousness Studies*, 6: 11–29.
Spence, S. A., Hunter, M. D., Farrow, T. F. D., Green, R. D., Leung, D. H., Hughes, C. J., et al. (2004). A cognitive neurobiological account of deception: Evidence from functional neuroimaging. *Philosophical Transactions of the Royal Society of London, Series B,* 359: 1755–1762.
Spence, S. A., Kaylor-Hughes, C. J., Farrow, T. F. D., & Wilkinson, I. D. (2008). Speaking of secrets and lies: The contribution of ventrolateral prefrontal cortex to vocal deception. *NeuroImage*, 40: 1411–1418.
Spitzer, M. (1992). Word-associations in experimental psychiatry: A historical perspective. In: *Phenomenology, Language and Schizophrenia*, ed. M. Spitzer, F. A. Uehleinm, M. A. Schwartz, & C. Mundt. New York: Springer-Verlag, pp. 160–196.
Talairach, J., & Tournoux, P. (1988). *A Co-planar Stereotaxic Atlas of a Human Brain.* Stuttgart: Thieme Verlag.
Thurston, L. (2004). *James Joyce and the Problem of Psychoanalysis*. Cambridge: Cambridge University Press.
Warren, J. D., Warren, J. E., Fox, N. C., & Warrington, E. K. (2003). Nothing to say, something to sing: Primary progressive dynamic aphasia. *Neurocase*, 9: 140–155.
Watson, B. (2004). *Derek Bailey and the Story of Free Improvisation*. London: Verso.
Wilmer, V. (1977). *As Serious as Your Life: The Story of the New Jazz*. London: Pluto Press, 1987.
Winck, C. (1962). Thoughts and feelings of the general population as experienced in free association typing. *American Imago*, 19: 67–84.

Not to be Confused about Free Association

Commentary by Ariane Bazan (Brussels)

The effort to articulate key psychoanalytic concepts in terms of the neurophysiology of action is a promising undertaking that opens perspectives for a fruitful dialogue between psychoanalysis and modern sensorimotor neurosciences. For this to happen it is important to operationalize these psychoanalytic concepts more precisely. In this commentary, articulate distinctions are proposed between free association and, respectively, (1) unconscious processing, (2) a minimally constrained executive task, (3) spontaneity and intentionality, (4) primary-process mentation, and (5) ego function. In particular, the opposite understandings of "free" as either "free of defense" or "able to choose beyond unconscious inclinations" are discussed.

Keywords: free association; unconscious; prefrontal cortex; primary process; intentionality; defense.

Reading psychoanalysis in the perspective of a neurophysiology of *action*—that is, in the growing body of knowledge about the complex role of the prefrontal cortex in intentionality, willed action, agency, etc.—is to me the most promising way to understand the organization of the mental apparatus, and I am therefore very enthused by the kind of research undertaken by Spence and his colleagues. From this perspective, it seems important to fine-tune some distinctions, which become critical when it comes to implement the psychodynamic concepts in the physiology of the brain.

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Free association—unconscious processing

In the target article "free association" is at some points presumed to be a probe for unconscious processing. However, as many clinicians know, associating is not *per se* delivering unconscious productions or reflecting unconscious processing. Associating might be one way to get to unconscious productions when at brief moments it indeed becomes *free* association. The adjective "free" then refers to *free of defense,* to the extent that this is possible. The clinician is interested in what the subject would say in the protected space and time of the clinical session were the subject to say what he or she feels most inclined to. However, it is observed that, although a ground rule for psychoanalysis, only few people really come to associate during analysis, and most often only for brief periods. Moreover, only now and then might there be reason to think that the association has freed itself from defense—for example, when slips of the tongue are made or when unusual, unexpected links or very precise links (e.g. involving names) are suddenly made. In other words, association is clinically not easy, and "free" association is even more difficult. Now, this does not therefore mean that fully conscious and (partially) "unfree" associations are "at random": they are always also determined by unconscious factors. In summary, association is informative of unconscious processing, as are other fully conscious productions, but it is not a probe to reveal brain processes specific to unconscious processing.

Free association—minimally constrained executive task

The authors propose that from a cognitive perspective, the vocal free association (VFA) resembles "a minimally constrained verbal executive task." This might be precisely the reason why the VFA is not a probe for unconscious processing. Indeed, one might rather suppose that unconscious processing reflects the internal *constraints* of the mental apparatus. A minimally constrained task might therefore encourage the executive to suppress the attractive power of these internal constraints. From this perspective, the role of the executive in the physiological model resembles the role of defense in the psychodynamic model. By way of illustration, here is a short example from my clinical practice. A young man whom I have been seeing for several months is progressively coming to allow some of his own aggressive inclinations. Lately he commented on a dinner he had with some friends and called the woman he sat next to "an old bag." I am inclined to think that this is what he has (also) been thinking about some women all along, as his over-friendly behavior toward them might suggest. Perhaps, in interaction with women, he engages his left dorsolateral prefrontal cortex (DLPFC) in order to make alternative behaviors possible rather than expedite the aggressive behavior he (sometimes) feels strongly inclined to. One might say that, in order to open up his response space beyond the constraining attractive power of aggressive themes, a defense-type or executive-type intervention is required. In the present VFA study, a majority of the associations probably reflect the search in a response set that is maintained as open as possible by the intervention of the left DLPFC: therefore, it makes sense that such a task would activate the prefrontal, cognitive executive, specifically in the region of the left DLPFC, as is revealed by the results of this study.

This is also coherent with the observation, made in a brain imaging study with schizophrenic patients, that "failure of executive processes to modulate lower centers might allow the emergence of stereotypic response patterns" (as in the stereotypies and perseverations encountered in schizophrenia) (Ganesan, Green, Hunter, Wilkinson, & Spence, 2005, p. 952). In other words, failure of the modulating influence of executive centers closes the response space along the limits determined by the subject's internal constraints. It can also explain why, in some aspects, the patient's discourse becomes more stereotypic over time—that is, with lesser defense, the unconscious constraints or inclinations are uncovered, showing the more fixed architecture of the mental apparatus. (I disagree with Jung, however, that they are, de facto, therefore of lesser value, since they might reveal the idiosyncrasies of the architecture of the subject's mental apparatus.)

It is important to notice how the word "free" can be read in two, opposing ways. Indeed, Hunter, Green, Wilkinson, and Spence (2004) mention a body of functional neuroimaging work implicating the DLPFC "in the free selection of response behaviors," including random number and letter generation, word stem completion, verbal fluency, and willed motor action. "Free" in either "free associations" or "free selection" has then two opposed readings: the first is "freed of/unhindered by" defense revealing unconscious inclinations; the other is "able to choose a response beyond unconscious inclinations, freed from unconscious constraints" or "having a minimally restrained response space." In the first meaning, free association reflects unconscious processing requiring *less* intervention of the executive; in the second meaning, free selection reflects conscious processing enabled by *significant* intervention of the executive.

Free association—spontaneity and intentionality

Another confusion concerning the notion of free association might reside in the understanding of "free" as "spontaneous": the confusion resides in the distinction between the notion of "unconstrained by defense or inhibition" on the one hand, and "spontaneous, self-initiating" on the other. The reality of this distinction is apparent in, for example, schizophrenic patients. Even patients who are not overwhelmed by so-called negative symptoms, but are vivid, active patients with a lot of positive symptoms, often have remarkable difficulties in initiating speech.[1] The spontaneous, auto-initiated uttering of an intention (especially in the "I" form) seems relatively difficult for a schizophrenic patient. But, when they are given a first stimulus or a first word, they have no difficulties in producing fluent speech, most often in the most unrestrained associative manner (see e.g. Van de Vijver, Bazan, Rottiers, & Gilbert, 2006). This segregation of spontaneous, self-initiated speech and associative speech also has its counterpart in transcortical motor aphasia, impairing specifically the capacity of initiating speech and leaving intact the capacity of responding to speech.

Nevertheless, one could say that the unconscious of psychoanalysis is not only thought of as a reactive unconscious, taking advantage of external stimuli to manifest itself momentarily, such as in parapraxes, but also as a motivated unconscious and the source of unconscious intentionality. One might even consider that intentionality is in essence unconscious, in the sense that every intention to act might start before or independently of conscious decision, as Libet's experiments suggest (Haggard & Libet, 2001; Libet, 1985, 2003; Libet, Gleason, Wright, & Pearl, 1983), and that the conscious experience of intentionality is a *post hoc* phenomenon that is perhaps achieved for only a fragment of the subject's intentions. Some, or more probably a majority, of the subject's intentions might never make it to full execution. However, this inhibition happens in a second step, and the emergence of intentions is thought to be the same whether or not any of them come to full execution: only one type of physiological mechanism is expected for their generation, involving the left DLPFC. Indeed, the left DLPFC has also been described as a candidate executive system for the self-initiation of action. For example, Jenkins, Jahanshahi, Jueptner, Passingham, and Brooks (2000) state that "the DLPFC is also seen to be activated when subjects self-initiate motor action (i.e., when they choose when to execute movements)." In other words, it is supposed that the activation of the left DLPFC takes place both for intentions gaining consciousness and for intentions remaining incompletely executed or remaining unconscious. In that sense, activation of the left DLPFC is not thought to discriminate between conscious and unconscious processing.

[1] Also, when writing, there is a remarkable deficit in sentences starting with "I": "I . . . [do/want/will, etc.]." And, when using these sentences, the "I" is often omitted such as in, e.g., "Want more money."

Free association—primary process

A fundamental distinction in the architecture of Freud's mental apparatus is that between primary and secondary processes.[2] From an ontological perspective, primary processes are thought to have arisen primarily to be able to "bounce back" upon stimuli arriving at the membrane of the "sensitive substance" (Freud, 1950 [1895]) in order to regain, as quickly or as efficiently as possible, a stable level of potential energy. Not every stimulus can be dealt with in this linear direct way, and, in particular, an organism cannot flee from the insisting stream of internal stimuli, such as, for example, hunger. To handle these stimuli, a mechanism must be deployed that acts adequately upon the external world and its objects in order to ease the tension—for example, by grasping a food object. These are the secondary processes. Secondary processes are therefore characterized by contextually appropriate action adapted to external reality and in tune with the subject's intentions. Primary processes, in contrast, search to rapidly equate the activation of an incoming stimulus with an internal response, present in memory or in fantasy: as Freud (1900) mentions, primary processes strive for "perceptual identity" on the basis of common, but possibly superficial, features. Moreover, in his model of the mental apparatus, it is the inhibitory function of the "ego" (see further) that fundamentally enables the emergence of secondary processes, and both this ego and the secondary processes then constrain the access of primary processes to consciousness.

If one preferential probe for unconscious processing has to be picked,[3] I would vote for it to be primary-process mentation, which is tied to diminished defense or inhibition. Indeed, when one's guard is down, it is primary-process mentation that most directly expresses the subject's unconscious inclinations. From that perspective, it seems no problem to work with an association task based on single words, nor is it a problem that associations "do not produce a straightforward, linear narrative structure." On the contrary, it is indeed observed clinically that in the rare moments of highly free association, the grammatical structure of sentences

[2] See also Bazan (2007b) for a neuropsychoanalytic approach to primary and secondary processes.

[3] Other probes might not be adequate: "unrestrained choice" is problematic since unconscious processing is internally restrained, and "spontaneity" is problematic to the extent that intentionality does not necessarily imply lesser defense.

gets lost or gets very unspecified.[4] Since grammar is a positional dynamic, it is a secondary-process instance, while primary process is characterized by linearity and position confusion, and therefore by an absence of grammar. As another example, in one of Shevrin's experimental set-ups, the subliminal stimulus preceding the free-association task was a rebus-like stimulus consisting of a drawing of a pen flanked by a drawing of a knee (Shevrin, 1973; Shevrin & Luborsky, 1958, 1961). In line with Freud's theory, phonological and rebus-type (e.g. "penny") associations were considered indicative of primary processes.

Schizophrenia is characterized by a predominance of primary processes and diminished secondary-process functioning.[5] The predominance of primary processes leads to associative speech resulting in situations where the unconscious is "at the surface" (Freud, 1900). Psychotic symptoms would then be the consequence of a lesser functioning of the ego and of the secondary processes, both of which lead to primary-process predominance. This psychodynamic model is coherent with the hypometabolism of left DLPFC in schizophrenia, which could be the physiological counterpart of the diminished inhibition of "stereotypic behavior," such as associative mentation. Indeed, the role of the prefrontal cortex has been repeatedly observed experimentally in the suppression or inhibition of "unadaptive," or "contextually inappropriate" (Fletcher, Shallice, & Dolan, 2000), or "habitual/stereotypic" (Jahanshahi, Dirnberg, Fuller, & Frith, 2000), or "previously rewarded" (Eliot, Dolan, & Frith, 2000) responses—adjectives all suggestive of primary-process functioning—in favor of "more adaptive" responses. For these and for other reasons (both theoretical and clinical), several authors (Bazan, 2007a; Kaplan-Solms & Solms, 2000; Solms, 2004) have suggested that the role of the prefrontal cortex is equivalent to the inhibiting role of the ego in Freud's topical model.

However, if the role of the prefrontal cortex, and in particular of the left executive, is comparable to the role of the ego, then one expects lower—and not higher—levels of activation of the left DLPFC correlating with unconscious processing. The most obvious reason to explain this contradiction with the present results is that the VFA did not in particular probe unconscious processing but, rather, and as indicated by Spence and colleagues, the search in a response set that was maximally opened up by the intervention of the DLPFC. In other words, as already suggested, people made an effort not to take what directly came to mind but to give "anything" a chance to come to mind.

Free association—self and ego

In my opinion, the results of the present study do not inform about unconscious processing but, rather, about Freud's concept of the "ego." In his topographical model, Freud uses the notions of "ego," "super-ego" and "id." The "ego" is a psychological instance with access to motor execution, which is pervaded by unconscious inclinations; these unconscious inclinations (coming from the "id") are not able to directly invest ("cathex") the motor execution pathways. Indeed, their passage through the ego will lead to the inhibition of some unconscious inclinations or to their transformation by defense mechanisms. These unconscious inclinations either will then be stopped or will find execution in derived or disguised forms, known as the "return of the repressed." For example, it is the ego instance that is the "executive, which may be called upon to prevent disclosure" when Freud says: "I really do not think that anyone would make a slip of the tongue in an audience with his Sovereign, in a serious declaration of love or in defending his honor and name before a jury—in short, on all those occasions in which a person is heart and soul engaged" (Freud, 1901). In the "Project" (1950 [1895]), Freud describes how the ego can only start to function after a certain period of maturation that has permitted the elaboration of a memory—that is, of a minimally ramified neuronal structure established by experience, which will slow down signal transduction and will allow the instantiation of an inhibitory function.

The authors pose a problem for psychoanalytic theory—namely, "is it the more purposeful (more guarded, and potentially less "honest") material that emerges early on in an analysis that is most significant, or is it that which emerges later on in the process?" First, I would suggest that the associative material emerging late in analysis is not easily accessible, but, instead, requires the relaxation of structural inhibitory mechanisms. Also, I am hesitant about the term "stereotypic." It is true that, at the level of the unconscious, "banal" associations will arise like "mummy–daddy"

[4] When at some moments, advanced in analysis, subjects start to talk in ungrammatical sentences or use phrases like "there has been," "it is understood that," "it is supposed that," or when there is a confusion of actors when mentioning an action, this can be a cue that the subject is talking at a more primary-process level and is more directly reflecting unconscious mental contents. Typically, this unspecified or loose grammatical structure, or confusion of the agent and object of an action, happens when subjects present dreams (e.g., one woman would start a dream report by: "it should be understood that there has previously happened something important to someone") or fundamental fantasies (e.g., "a child is being beaten," Freud, 1919).

[5] This was also confirmed empirically (Bazan et al., 2007).

or basic love–hate dichotomies, but, at the same time, it is there where the interesting idiosyncrasies will suddenly appear that characterize the subject by standing out from the expected associations. So, I would rephrase the question as "whether it is the associative material emerging later in analysis that holds greater meaning or that which appears more purposeful (more guarded) earlier on." I do not think that this poses a problem to psychoanalytic theory, since, of course, both sources of material are very meaningful. Most often (but not always), the analysis starts with the more guarded material, in which it may not be very difficult to feel the transformation of the original unconscious inclinations. This more "purposeful" or more guarded material betrays the unconscious by being the "return of the repressed." A classical example is that overfriendly people are often dealing with unconscious insistent aggressive inclinations. But there are lots of other, more subtle, ways of "derivation" or "disguise." This material is as meaningful as the more direct testimonies of the unconscious that may come later during the analytic process. So, indeed, as the authors indicate, "the repressed" and "its return" may be "interpreted as opposite sides of the same coin: the 'truth' that compels the executive to limit disclosure may be the same truth that emerges when the executive is distracted or 'relaxed'." However, I would add that when you have direct access to the repressed, you have direct access to the unconscious—whereas when you are dealing with "the return of the repressed," you have an indirect access that is marked by the intervention of the executive and you deal with the "ego," the same ego that is thought to be at work in "the early phase of the psychoanalytic process, during resistance."

REFERENCES

Bazan, A. (2007a). An attempt towards an integrative comparison of psychoanalytical and sensorimotor control theories of action. In: *Attention and Performance XXII*. New York: Oxford University Press, pp. 319–338.

Bazan A. (2007b). *Des fantômes dans la voix. Une hypothèse neuro-psychanalytique sur la structure de l'inconscient.* Collection Voix Psychanalytiques. Montreal: Editions Liber.

Bazan, A., De Kock, L., Van Draege, K., Brakel, L. A. W., Geerardyn, F., & Shevrin, H. (2007). *Empirical Evidence for Primary Process Mentation in Acute Psychosis*. Paper presented at the Research Day of the 7th International Neuropsychoanalysis Conference, Vienna, Austria, 22 July.

Elliot, R., Dolan, R. J., & Frith, C. D. (2000). Dissociable functions in the medial and lateral orbitofrontal cortex: Evidence from human neuroimaging studies. *Cerebral Cortex,* 10: 308–317.

Fletcher, P. C., Shallice, T., & Dolan, R. J. (2000). "Sculpting the response space"—An account of left prefrontal activation at encoding. *NeuroImage*, 12: 404–417.

Freud, S. (1900). *The Interpretation of Dreams*. *Standard Edition,* 4/5.

Freud, S. (1901). *The Psychopathology of Everyday Life*. *Standard Edition,* 6.

Freud, S. (1919). A child is being beaten. *Standard Edition,* 17.

Freud, S. (1950 [1895]). Project for a scientific psychology. *Standard Edition,* 1: 281–392.

Ganesan, V., Green, R. D., Hunter, M. D., Wilkinson, I. D., & Spence, S. A. (2005). Expanding the response space in chronic schizophrenia: The relevance of left prefrontal cortex. *NeuroImage*, 25: 952–957.

Haggard, P., & Libet, B. (2001). Conscious intention and brain activity. *Journal of Consciousness Studies*, 8: 47–63.

Hunter, M. D., Green, R. D. J., Wilkinson, I. D., & Spence, S. A. (2004). Spatial and temporal dissociation in prefrontal cortex during action execution. *NeuroImage*, 23: 1186–1191.

Jahanshahi, M., Dirnberg, G., Fuller, R., & Frith, C. D. (2000). The role of the dorsolateral prefrontal cortex in random number generation: A study with positron emission tomography. *NeuroImage*, 12: 713–725.

Jenkins, I. H., Jahanshahi, M., Jueptner, M., Passingham, R. E., & Brooks, D. J. (2000). Self-initiated versus externally triggered movements. II. The effect of movement predictability on regional cerebral blood flow. *Brain*, 123: 1216–1228.

Kaplan-Solms, K., & Solms, M. (2000). *Clinical Studies in Neuro-Psychoanalysis: Introduction to a Depth Neuropsychology*. London: Karnac.

Libet, B. (1985). Unconscious cerebral initiative and the role of conscious will in voluntary action. *Behavioral and Brain Sciences*, 8: 529–566.

Libet, B. (2003). Can conscious experience affect brain activity? *Journal of Consciousness Studies,* 10: 24–28.

Libet, B., Gleason, A. G., Wright, E. W., & Pearl, D. K. (1983). Time of conscious intention to act in relation to onset of cerebral activity (Readiness-Potential): The unconscious initiation of a freely voluntary act. *Brain*, 106: 623–642.

Shevrin, H. (1973). Brain wave correlates of subliminal stimulation, unconscious attention, primary and secondary process thinking, and repression. In: *Psychoanalytic Research: Three Approaches to the Study of Subliminal Processes*, ed. M. Mayman. Psychological Issues, 30. New York: International Universities Press, pp. 56–87.

Shevrin, H., & Luborsky, L. (1958). The measurement of preconscious perception in dreams and images: An investigation of the Poetzl phenomenon. *Journal of Abnormal and Social Psychology*, 56: 285–294.

Shevrin, H., & Luborsky, L. (1961). The rebus technique: A method for studying primary-process transformations of briefly exposed pictures. *Journal of Nervous & Mental Disease*, 133: 479–488.

Solms, M. (2004). Freud returns. *Scientific American*, 290: 83–88.

Van de Vijver, G., Bazan, A., Rottiers, F., & Gilbert, J. (2006). Enactivisme et internalisme. De l'ontologie à la clinique. *Intellectica*, 43: 93–103.

Free Association as a Bridging Concept between Dynamic and Cognitive Processes and the Nature of Psychotherapeutic Change

Commentary by Andrew J. Gerber (New York)

The target article is a subtle, but important, step in the direction of weakening two persisting barriers in psychoanalytically relevant research. First, the authors' investigation of free association through a verbal fluency task and their discovery of the role of the dorsolateral prefrontal cortex (DLPFC) in this process demonstrate that "cognitive" concepts such as executive function, attention, and working memory and "analytic" concepts such as free association, defense, and resistance all belong in a single category of mental functions. Second, by understanding free association through its effect on executive function and the DLPFC, one can see that the therapeutic action of psychodynamic, cognitive, and interpersonal treatments may not be fundamentally different.

Keywords: free association; psychotherapy; therapeutic change; attention; fMRI; DLPFC.

Empirical research, at its most effective, is gently subversive. A carefully supported finding does not disprove old orthodoxies all at once but, rather, quietly loosens a single stone in a wall that begins to wobble and shake, years, if not decades, before it tumbles down. In their target article, Spence and colleagues use findings from a functional magnetic resonance imaging (fMRI) study of so-called free association to weaken two unhelpful barriers in the worlds of psychoanalysis and cognitive neuroscience. First, by exploring the role of the dorsolateral prefrontal cortex (DLPFC)—a region of the brain whose function has long been interpreted in terms of cognition and executive function (Miller & Cohen, 2001)—in free association, they demonstrate that the distinction between processes historically thought of as "cognitive" versus "dynamic" is a false one. Executive function, attention, and working memory play central roles in free association, defense, and resistance and do not belong to a different category of mental processes. Second, their work suggests tools to study whether the proposed mechanisms of action of psychoanalysis and psychoanalytic psychotherapy are, in fact, fundamentally different from those treatments thought to be less intrinsically "dynamic" such as cognitive behavioral therapy (CBT), supportive psychotherapy, and interpersonal psychotherapy (IPT). Psychoanalytic treatments, which use free association as a principal tool, may work by decreasing resistance and self-censorship, characterized by a change in activity of prefrontal regions, such as the DLPFC. When free association is understood in terms of its effect on executive function and the DLPFC, it begins to sound less distinct from the practiced alteration in automatic thoughts and improvement in coping strategies, which are central to nondynamic forms of psychotherapy. Thus, it opens up, and even suggests a possible method for testing, the question of whether the neural mechanisms underlying improvement in different forms of psychotherapy are the same or different.

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What is "free association"?

The very first question raised, albeit implicitly, by Spence and colleagues is whether "free association" is correctly named. It is well accepted by psychoanalytic clinicians that though free association may be an instruction to and a theoretical goal for a patient, the speech of even the least resistant patient is necessarily constrained both consciously and unconsciously in a wide variety of ways. The very structure of language and the necessity of explaining background material and presenting thoughts and feelings in the context of a narrative already narrows the options of the patient in presenting his or her thoughts. Patients also both explicitly and implicitly quickly figure out the kind of material that their therapists/analysts view as "interesting" or worthy of follow-up, and a skilled therapist is perpetually sending signals to the patient (sometimes consciously, sometimes unconsciously) by choosing which material to comment on. As with dreams, the content of a given session is as filled with manifest content, usually related to day (or "real life") residue, as it is with the latent content, on which the therapist/analyst will often focus. In the target article, this aspect of free association is evident in the comparison between what happens in therapy and verbal fluency tasks such as listing "words beginning with the letter F." Though the historical theoretical focus on these tasks may have been very different, the practical nature of what a subject is doing—that is, generating words with fewer constraints on narrative structure than we are accustomed to in our everyday lives—may be the same.

An understanding of free association in psychoanalysis is closely tied, both in an experimental and in a clinical sense, to what we mean by resistance, particularly resistance to free association. Though classically resistance was often thought of in terms of defiance of the analytic authority or the omission of important information (Freud, 1912), a more contemporary view of resistance regards it as a complex and nonpathological process that helps the analyst and patient learn more about unconscious conflict and interpersonal dynamics outside of awareness (Schafer, 1973). Therefore, as we study free association empirically, we are inevitably studying all those normal, as well as pathological, processes that interfere with it (Kris, 1996). Or perhaps it would be more appropriate, particularly given the results of Spence and colleagues, to set aside the extremes of "free association" versus "resistance" and think instead of the infinite variety in how individuals attend to and spontaneously report thoughts and feelings.

Reconceptualizing free association in this way clears a path toward devising more precise metrics for understanding how individuals respond to instructions to free associate. In the target article, for example, it would be useful to know in much more explicit detail how the subjects are instructed to free associate and how subjects differ in terms of how they understand and execute these instructions. In addition to the person-specific or "trait" aspects of free association, one would certainly imagine that there are "state" and developmental influences as well. Once an adequate metric of free association is available, it will be possible to study all these factors more systematically and ultimately to apply them to understanding the results of functional neuroimaging experiments.

The neural basis of psychotherapeutic change

The nature of psychotherapeutic change is one of the most enduring mysteries of both theoretical clinical and empirical investigations of the therapeutic process. Though the unconscious is just as important to contemporary theories of psychoanalysis as it was in the days of Freud, newer ideas about psychotherapeutic change, particularly those emerging from empirical researchers, have noticeably shifted toward emphasizing the role of non-repressed and even conscious cognition in the alteration of defense mechanisms, object representations, and character structure. Fonagy has commented, for example, that "Classically, psychoanalysis has not paid the phenomenon of consciousness the attention it deserves" (Fonagy & Allison, submitted). It is the capacity to see ourselves as "conscious, intentional agents in a coherent world of objects," Fonagy points out, that makes it possible to regulate affect, negotiate conflict, and forge healthy relationships.

Coming from the perspective of cognitive neuroscience and the empirical investigation of psychiatric disorders, Peterson (2005) has emphasized the development of *compensatory factors* in determining the nature and severity of psychological symptoms. Thus our theories of psychopathology must take into consideration both the internal pressures of drives, early experiences, and the conflict they engender, as well as the conscious and unconscious compensations that we develop to cope with them. These compensations are not equivalent to what was classically meant by defense mechanisms, though, like defenses, they can be healthy or can cause symptoms of their own. Peterson's theory of compensatory factors is rooted in growing evidence that genetic vulnerability to a psychiatric illness confers risk, but the appearance of symptoms is correlated with the lack of an appropriate compensatory response in growth of the prefrontal cortex (Peterson et al., 2009). Differences in subcortical development are more closely related with early and fundamental difficulties, while cortical development is more indicative of compensation or the lack thereof (Peterson et al., 1998; Spessot, Plessen, & Peterson, 2004).

More concrete evidence about the brain changes that occur in response to psychotherapy is already emerging and is directly relevant to the findings that Spence and colleagues report (Roffman & Gerber, 2008). To date, at least 27 published studies have measured brain changes after psychotherapy with fMRI (n = 11), PET (n = 7), SPECT (n = 5), EEG (n = 2), structural MRI (n = 1), or Xenon-enhanced CT (n = 1). Just over half the studies have been of cognitive-behavioral treatments, and the rest evenly distributed amongst IPT, group, cognitive rehabilitation, eye movement desensitization and reprocessing (EMDR), and dynamic psychotherapies. Psychiatric diagnoses studied include anxiety disorders (obsessive-compulsive disorder: n = 6; phobias: n = 6; posttraumatic stress disorder: n = 3), depression (n = 6), and a handful of others (schizophrenia: n = 3; personality disorders: n = 2; chronic fatigue: n = 1). Sample sizes have been relatively small (ranging from n = 1 to n = 28), and no studies have used more than one follow-up scan or compared more than one psychotherapy within the same protocol.

Nonetheless, the results are intriguing. In one study of IPT for major depressive disorder, subjects showed decreased metabolism in dorsal and medial prefrontal regions and increased metabolism in the temporal lobes (Brody et al., 2001) following treatment. In another, of cognitive-behavioral therapy (CBT) for major depression, treatment response was associated with decreased activity in dorsal, ventral, and medial frontal cortex and increased activity in hippocampus and dorsal cingulate cortex (Goldapple et al., 2004). Combining these with the results of the target article, we may hypothesize that successful psychotherapy *decreases* the extent to which the DLPFC inhibits spontaneous attention to and reporting of internal experiences (what Spence and colleagues call free association). I propose two possible causes for this change: (1) a change in compensatory factors/defense mechanisms from forced inattention (i.e., repression) to more nuanced and affectively integrated personal narratives (i.e., the results of healthy grieving); or (2) a decreased *need* for inattention or censorship resulting from addressing more basic causes of psychological distress.

Implications for theory and future research

Psychoanalytic theory, for so long preoccupied with internal political battles and interesting but difficult-to-prove assertions backed up by subjective clinical reports, stands to gain a great deal from methodology and data of this sort. An empirical method for quantifying attention to internal processes could allow testing of how ego capacities and vulnerabilities affect object representations and their associated affect. The study of individual differences with regard to such strengths and weaknesses would allow a more sophisticated elaboration of character structure and its relationship to problematic defenses and behaviors (Lane & Garfield, 2005). Implications for treatment of all kinds are perhaps even more profound. An integration of techniques for facilitating exploration of internal processes across a range of therapeutic modalities (e.g., dynamic, CBT, IPT, and supportive psychotherapy) promises to break down arbitrary barriers and allow a more appropriate appraisal of when and in which therapist–patient pair each technique is most usefully applied.

Finally, Spence and colleagues have demonstrated the feasibility of research that integrates cognitive neuroscience and psychoanalytic concepts and thus made clear how much more research of this type needs to be done to advance the field. Research must address how the ability to attend to and describe internal processes is associated with various types and degrees of psychopathology and how it changes in response to treatments. Furthermore, we need to know how this ability develops normally and how, presumably, this can go off course given specific perturbations to the individual's constitution and environment. Finally, we must study the way this particular facility is related to and/or is distinct from other measurable processes including transference (Gerber & Peterson, 2006), affect regulation (Ochsner, Bunge, Gross, & Gabrieli, 2002), and attentional/cognitive control (Eigsti et al., 2006; Wager, Jonides, Smith, & Nichols, 2005). The shift begins gently, but the consequences may prove profound.

REFERENCES

Brody, A. L., Saxena, S., Stoessel, P., Gillies, L. A., Fairbanks, L. A., & Alborzian, S., et al. (2001). Regional brain metabolic changes in patients with major depression treated with either paroxetine or interpersonal therapy: Preliminary findings. *Archives of General Psychiatry,* 58: 631–640.

Eigsti, I. M., Zayas, V., Mischel, W., Shoda, Y., Ayduk, O., & Dadlani, M. B., et al. (2006). Predicting cognitive control from preschool to late adolescence and young adulthood. *Psychological Science,* 17*:* 478–484.

Fonagy, P., & Allison, E. (submitted). Mirroring and consciousness: A clinical illustration of the limitations of a mentalization enhancing technique. *International Journal of Psychoanalysis.*

Freud, S. (1912). The dynamics of transference. *Standard Edition,* 12: 97–108.

Gerber, A. J., & Peterson, B. S. (2006). Measuring transference phenomena with fMRI [abstract]. *Journal of the American Psychoanalytical Association,* 54: 1319–1325.

Goldapple, K., Segal, Z., Garson, C., Lau, M., Bieling, P., & Kennedy, S., et al. (2004). Modulation of cortical-limbic pathways in major depression: Treatment-specific effects of cognitive behavior therapy. *Archives of General Psychiatry,* 61: 34–41.

Kris, A. O. (1996). *Free Association: Method and Process* (revised edition). London: Karnac.

Lane, R. D., & Garfield, D. A. S. (2005). Becoming aware of feelings: Integration of cognitive-developmental, neuroscientific, and psychoanalytic perspectives. *Neuropsychoanalysis,* 7: 5–30.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience,* 24*:* 167–202.

Ochsner, K. N., Bunge, S. A., Gross, J. J., & Gabrieli, J. D. (2002). Rethinking feelings: An FMRI study of the cognitive regulation of emotion. *Journal of Cognitive Neuroscience,* 14*:* 1215–1229.

Peterson, B. S. (2005). Clinical neuroscience and imaging studies of core psychoanalytic constructs. *Clinical Neuroscience Research,* 4*:* 349–365.

Peterson, B. S., Skudlarski, P., Anderson, A. W., Zhang, H., Gatenby, J. C., & Lacadie, C. M., et al. (1998). A functional magnetic resonance imaging study of tic suppression in

Tourette syndrome. *Archives of General Psychiatry,* 55: 326–333.
Peterson, B. S., Warner, V., Bansal, R., Zhu, H., Hao, X., & Liu, J., et al. (2009). Cortical thinning in persons at increased familial risk for major depression. *Proceedings of the National Academy of Sciences U.S.A.,* 106: 6273–6278.
Roffman, J. L., & Gerber, A. J. (2008). Neural models of psychodynamic concepts and treatments: Implication for psychodynamic psychotherapy. In R. Levy & J. S. Ablon (Eds.), *Handbook of Evidence-Based Psychodynamic Psychotherapy*. Totowa, NJ: Humana Press, pp. 305–338.
Schafer, R. (1973). The idea of resistance. *International Journal of Psychoanalysis,* 54: 259–285.
Spessot, A. L., Plessen, K. J., & Peterson, B. S. (2004). Neuroimaging of developmental psychopathologies: The importance of self-regulatory and neuroplastic processes in adolescence. *Annals of the New York Academy of Sciences,* 1021: 86–104.
Wager, T. D., Jonides, J., Smith, E. E., & Nichols, T. E. (2005). Toward a taxonomy of attention shifting: Individual differences in fMRI during multiple shift types. *Cognitive, Affective & Behavioral Neuroscience,* 5: 127–143.

Therapeutic Free Association Is a Unique Cognitive, Affective, and Verbal Action Warranting Further Psychoanalytic and Neural Investigation

Commentary by Robert D. Scharf (New York)

The research presented in the target article is a valuable first fMRI study of free association, using an externally paced, five-word model. Although Freud's instructions to patients seemed to be solely cognitive, contiguously connected statements suggested that there are automatically connected feelings and emotional conflicts. The noteworthy complexity of experimental vocal free association (VFA) is demonstrated by very widespread left dorsal, lateral, and inferior prefrontal fMRI signal activations. The investigation focuses on cognitive features only, yet it quotes some of the subject's five-word groupings of coherent, evocative, emotional themes. No psychological operation can be solely cognitive, since psychologically, during waking life cognition, affect, and some degree of emotional conflict are always present. Correspondingly, cognitive and affective neural operations are always cotemporally functioning and integrated in the whole brain. The research model of free association *suggests* features of simple forms of spontaneity, thematic confluence, and affective expressiveness. Therapeutic free association is more complex and is inextricably part of the ebb and flow of the psychoanalytic treatment process. It has at least seven more features, including narratives of immediately lived experience; expressions of emotional conflict; memories, fantasies, and dreams; experiences of the therapist and treatment situation; self-esteem; and awareness of one's own problems. It is, uncertainly, speculated here that free association may bring and transform less symbolic and less conscious mental formations, which may correspond to subcortical, paralimbic, and secondary cortical neural processing, into more symbolic and more conscious mental formations, which correspond to the highest levels of cortical neural processing. It seems important to study therapeutic free association to further psychoanalytic, and neural, understanding of thought, language, and consciousness.

Keywords: free association; neuroimaging; psychoanalysis; emotion; consciousness; linguistics.

The work by Spence and colleagues is a valuable neuropsychological fMRI study aimed at a very important psychoanalytic entity, free association, which is a fundamental part of the psychoanalytic treatment procedure. The research creates a neural mooring of techniques and findings that are needed to proceed to more complex paradigms of free association. It also serves to inform observations and hypotheses about free association, coming from clinical psychoanalysis, and assists in confirming, disaffirming, and expanding this central part of clinical practice. I conjecture, as do many psychoanalysts, that a relatively high capacity for free association—occurring during treatment or in everyday life—is a major feature of a healthy and adaptable mind. The apparent increased flexibility of mental elements, when they enter a state of conscious awareness, seems to improve their potential for spontaneous rearrangement and it constitutes the first recognized, and most fundamental, mechanism of change in psychoanalytic treatments (Freud, 1940 [1938]; Jackson, 1887).

Scientific knowledge is deepened and confirmed

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by using multiple strategies to explore the same entity by divergent methods—in this instance, studying free association by joining qualitative natural science observations during psychoanalytic treatments and quantitative data from an fMRI paradigm. Functional magnetic resonance imaging is a highly sensitive, rapid, dynamic imaging method well suited to examining the complex and dynamic nature of free association. The target article expands and applies methods of assessing fluency derived from previous imaging research on aphasia and somatic movements (Rosser & Hodges, 1994). In order to study the brain fMRI activations that correspond with vocalized free association, interference from the head and face/tongue/throat movements accompanying speech production must circumvented (Gracco, Tremblay, & Pike, 2005). Applying prior work from the authors' and others' fMRI labs for dealing with motion interference, this study uses a "sparse method," during which vocalization is followed by a delay, allowing the motion effects to subside before the fMRI signal acquisition.[1] The project's data has been generated using regularly rhythmic, externally paced, five serial word, free association. Although the work is illuminating in its own right, it can serve as an anchor for designing future, more complex paradigms that more closely model therapeutic free association (Busch, 1995).

Spence and colleagues' working definition of free association is presented through a group of related short quotes from various authors: Galton (1879), Freud as quoted by Ellenberger (1970) and Livingstone Smith (2004), and a half dozen other sources, importantly including some work of Kris (1996). The authors largely adhere to Freud's early instruction to his patients—that they should reveal their thoughts as freely as they can, without selection or censorship, whether seeming trivial or offensive, and reach toward a procedure where their thoughts spontaneously pass into their minds (*Einfälle*)[2] (Freud, 1909). Freud's cognitive definition of free association was restated throughout his writings (1909, 1940 [1938]), but I believe there were explicit, and implicit, suggestions in contiguously connected statements, that associated feelings, conflicts, and, other crucial emotional contents were automatically attached to the thoughts.[3] As Freud's writings and the work of others progressed, it was shown that emotional defensive operations could decrease the strength of connections between the cognitive and feeling sides of experiences, or could defensively amplify or diminish the strength of the feelings (Abend, Porder, & Willick, 1983; Brenner, 1982; Freud, 1926).[4]

Spence and colleagues state that the psychoanalytic technique of free association

> has been regarded as a probe of the psychodynamic 'unconscious." However, when viewed from a cognitive perspective, it resembles an executive task requiring subjects to generate a novel sequence of actions (words) in the relative absence of external constraint. We hypothesized that, under experimental conditions, a variant of such a task, vocal free association (VFA), would activate the prefrontal, cognitive executive, specifically the region of the left DLPFC.[5] . . . Our findings confirm . . . [that] VFA is associated with activation of the left DLPFC (and other prefrontal regions) . . . within the prefrontal executive. Nevertheless, a question remains: to what extent is "our" VFA protocol a "good-enough" proxy for that form of free association occurring in the therapeutic environment?"

In the VFA paradigm, five words are serially freely associated in response to external pacing by the auditory prompt "Now" every 6 s.[6] The experiment seeks to test the hypothesis that the neural counterpart of this version of verbal free association is the so-called

[1] The method used is BOLD (blood oxygen level-derived), echo-planar imaging (EPI) based on local area oxyhemoglobin vs. deoxyhemoglobin signal increases. These localized increases in oxygenated blood flow have been correlated with higher localized brain activity. There is a 2–4 s lag between the head and mouth/lip/tongue/throat vocalization movements and the onset of the fMRI signals related to blood flow, which can isolate the fMRI signals from distortions due to the motion. Nonetheless, motion distortions of the general magnetic field, potentially, can persist beyond this time lag and interfere with slice phasing and signal intensities.

[2] *Einfall*: sudden idea, brain wave, fancy, notion; *witziger Einfall*, flash of wit; *wunderlicher Einfall*, whim, conceit (*Cassell's German Dictionary*, 1978).

[3] The term emotion here denotes expressions of drive impulse, subjective feeling, affect (organism-wide mind/body affect), and mood.

[4] There are thoughts that are strongly separated from related affective expressions, such as occurs in the defensive "isolation" found in obsessional neurosis. Amplification of feelings is a frequent hysterical defense, and diminishment of feelings a frequent obsessional defense.

[5] The dorsolateral prefrontal cortex.

[6] This interval is the echo-planar imaging (EPI) repetition time. It is the full cycle of the vocalization of one of five words at the start of an imaging pause, which is followed at the end of the pause by the brain imaging of the just spoken word. The word is spoken at the onset of a 3-s imaging pause during which the magnetic field's distortions, due to the vocalization motions, are also allowed to dissipate toward a baseline equilibrium. It is followed by a 3-s imaging sequence with the banging noises from the slicing gradient activities, which together completes the 6-s cycle. The next 3-s pause follows as the second word is spoken in response to the next prompt.

Even though the sparse method has been used, it would be helpful if the target article mentioned whether the data was tested for motion interferences. It has been reported that, even while using the sparse method, significant motion effects can occur in the three linear directions, in the three nonlinear directions, and in signal intensity. These distortions have been reported to be retrospectively measurable, and remediable, using mathematical calculations (Gracco, Tremblay, & Pike, 2005).

prefrontal executive, principally the left DLFPC.[7] The authors also aim at demonstrating that two related but more constrained kinds of verbal fluency, orthographic fluency (OF) and semantic fluency (SF),[8] which are similarly externally paced, will also activate the left prefrontal cortex—but to a lesser extent. A baseline task of the subject repeating the word "now" is subtracted from the three forms of fluency, eliminating some basic activations that correspond with the vocalization of all three fluencies—for example, the primary motor cortex and caudal part of Broca's area.[9]

While the dorsolateral PFC is the major dorsal PFC area, and is strongly activated during VFA, the study shows *extensive* additional dorsal, lateral, and inferior frontal PFC activations when contrasted with the verbalization of control words. This large aggregate of activations extends forward from the entire vertical (dorsal to ventral) length of the precentral sulcus, just anterior to the primary motor area, and continues forward to include the rostral anterolateral PFC. It approximates a broad, anterior facing, truncated triangle.[10] These activations are more far-reaching on the left than on the right. The *extent* of the neural activations associated with VFA suggests that it is a very complex cognitive and verbal activity. Vocalizing and related thinking seem strongly yoked together. It is likely that the activations correspond with the combination of cognitive and verbal actions, and the combination will prove to be functionally, and correspondingly neurally, different from silent free association.

Therapeutic free association, TFA, includes the social function of telling the free associations to the therapist and intermittently listening to the therapist's responses. The only two areas activated during VFA that might be related to emotional and social functioning are the rostral cingulate BA 32, which is the only *medial* area activated, and BA 38, the superior anterior temporal gyrus. BA32 may be activated because it participates in complex affects, such as the social affect guilt (Moll et al., 2005) or emotional conflict (Etkin, Egner, Peraza, Kandel, & Hirsch, 2006).

As mentioned above, Freud indicated that various aspects of emotion and emotional conflict occurred simultaneously with cognition during free association. Spence and colleagues present a somewhat similar link between cognition and affect in their results and discussion sections, where they indicate that some of the subject's associations show significant confluences of word themes, and some of those seem explicitly or implicitly affectively charged. They express feelings such as: fearfulness "*heart*, *surgeon*, *theatre*, *operation*, *gown*"; destructiveness/violence "over, cricket, *bat*, *Dracula*, *demon*"; sensuality/sexuality "*pink*, *feather*, *bird*, *pole*, *dance*"; or pleasantness/happiness "*breathe*, *freedom*, *still*, *calm*, *laughing*. These groups of words appear to have themes that are potentially scalable for both confluence and affective intensity. The article proposes that the confluences of the themes and emotions might prove the genuine freedom of the associations and establish a similarity between VFA and psychoanalytic TFA. The article does not attempt to show the frequency, or degree, of thematic confluence or affective intensity in the whole data set, which might more strongly support their use as indicators of

[7] In addition to the heteromodal DLPFC, which subsumes many executive functions, there are two other major prefrontal heteromodal executive nodes: the orbital prefrontal cortex (OPFC), the major executive node of the affect/mood network, and the rostral anterior prefrontal cortex (rAPFC), the highest cognitive, affective, and motor executive node in the brain. There is also a parietal major executive heteromodal node area (Gilbert et al., 2006; Mesulam, 2000) .

[8] Orthographic fluency consists of words with the same first letter, and semantic fluency consists of words in the same category, both of which have been used to study aphasia (Rosser & Hodges, 1994).

[9] The primary motor area, M1, independently executes motor tasks that are prepared further forward in the inferior frontal and dorsolateral prefrontal cortex.

[10] In the overall layout of the activated area of the lateral and inferior prefrontal regions, there is a dorsolateral and lateral band of areas extending forward from the precentral sulcus. The dorsal band starts with BA 6, the lateral and medial supplementary motor areas, concerned with planning complex and coordinated movements; next rostrally is BA 8, also involved in complex movement including eye field movements; and the most rostral areas of the dorsal band are BA 9 and 46, lying dorsal and caudal to the frontal pole. They are the modally nonspecific dorsolateral PFC proper, mediating attention, working memory, motor preparation, and movement monitoring—including vocalization preparation and monitoring.

The two inferior frontal areas BA 44 and 45 together form Broca's area and lie anterior to the precentral sulcus and inferior to BA 6 and 8. BA 44 is not demonstrably activated during VFA because of the baseline subtraction. BA 44 and B 45 mediate semantic and phonological processing. BA 47, the ventrolateral prefrontal cortex, is inferior to BA 45 and has multiple functions, including the processing and monitoring of syntax. It also modulates affect intensity (Grimm et al., 2006; Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007), activates with guilt stimulation (Moll, Zahn, Oliveira-Souza, Krueger, & Grafman, 2005), and is consistently activated during major depressive episodes (Drevets, 2007).

Lateral BA 10 is particularly active in working memory and retrieval of episodic memories. Lateral and medial BA 10 coordinate, integrate, and balance all the momentary activations involved in brain-wide multiple tasking (Luria, 1973; Mesulam, 2000). Mentalizing, emotional, self-referencing, and imagination functions are much more medially than laterally segregated (Gilbert et al., 2006, 2007; Turner, Simons, Gilbert, Frith, & Burgess, 2008) the similarity of experimental VFA and clinical TFA. The frequency and degree of thematic confluence and emotional expressiveness for a particular kind of free association, or fluency, or for a particular clinical subject might provide indication of the degree of the fullness and freedom of association.[11]

The authors suggest that an additional similarity of VFA and clinical psychoanalytic TFA[12] is the subject's reclining position in the scanner, free from external stimulation, which might somewhat match the patient's position in psychoanalysis. More importantly, they conjecture that experimental VFA might be similar to the TFA that appears at the beginning of a psychoanalytic treatment. During that time, dynamic emotional conflict, accompanied by strong defensive (state) resistances, and strong psychological structural (characterological, personality state/trait) resistances, resulting from vicissitudes during development, are present and impede the free expression of highly personal emotional revelations. Although a method for assessing for the presence of emotional conflict during a vocal fluency has not yet been established, I would conjecture that some emotional conflict probably occurs during some of the emotionally charged five-word VFA responses. Emotional conflict has been shown to be a mixed emotional and cognitive psychological entity, which seems to be more emotional than cognitive.[13] If either confluent affective expressions or emotional conflict were significantly formally demonstrated in VFA, then VFA would clearly be established as both a cognitive and an affective neuropsychological entity.

It would have been epistemologically much clearer if the authors had explicitly stated in their introduction or methods section that their paradigm would only address the cognitive part of VFA with its related BOLD activations, *although affective features must also exist*. They might later state that their findings for VFA suggest both cognitive and affective features, although they specifically pursued only the cognitive features.

Stating what I believe is a useful generality, with which the authors may well agree, no mental operation can be solely cognitive and independent of affect, because psychologically cognition, affect, and some degree of emotional conflict are always in action during waking life (Brenner, 1982; Freud, 1926). Correspondingly, cognitive and affective neural operations are, of course, cotemporally functioning in the whole brain as part of the dorsal and ventral streams, respectively. The two streams move continuously from the posterior perception areas rostrally toward the ventral affective areas and dorsal cognitive, memory, attention, and motor areas, while there are simultaneous integrations between the two (Braak, Braak, Yilmazer, & Bohl, 1996; Mesulam, 2000).

The authors speculate that the prefrontal executive may be the neural substrate of the ego, the presumed executive entity of the mind as has been conceived by Freud and his later psychoanalytic advocates. I principally, but not exclusively, follow the literature and practice of current conflict-ego psychology, which has fairly widespread application in the United States. I believe that the working definitions of ego, executive functions, self, and their interrelationships are still far from readily agreed upon in the United States, or elsewhere for that matter. It makes designing fMRI paradigms for the neural correspondences of any of the above constructs very difficult. There are some scales that might be useful, but they have not been sufficiently validated and standardized (Bellak & Meyers, 1975).[14] Moreover, the various other psychoanalytic groups—current Kleinian; object relations; Lacanian; self psychology; interpersonal; Boston Change Process Study Group (2007); relational psychoanalysis—use the term ego differently, or not at all.

The authors also speculate that the prefrontal

[11] The full data set might also allow correlations between the amount of the VFA theme confluence or emotional intensity and the localizations and signal intensities of the fMRI activations. Moreover, if limbic (amygdala, hippocampus, ventral striatum) and the paralimbic areas (cingulate, orbital prefrontal, and temporal pole cortices) had been designated as regions of interest (ROI), there might have been subcortical affective system areas of activation seen during VFA, besides the thalamic and dorsal basal ganglia activations shown in Table 1 in the Target Article. Such activations might also have been tested for correlations with thematic confluence or emotional expressiveness. Besides their designations as ROIs, identifying limbic and paralimbic activations would depend on the sensitivity and discrimination possible at 1.5 Tesla.

[12] For the rest of this Commentary, psychoanalytic TFA will be referred to only as TFA. Spacal (1990) suggests that the alternative types of psychoanalysis can be differentiated by the ways they use free association. Psychoanalytic free association is used here to mean the kind of free association that is part of the psychoanalytic process, as described below by Kris (1996), Loewenstein (1963), and Busch (1995).

[13] Emotional/cognitive conflict is demonstrated in fMRI experiments by Etkin and colleagues (2006) that employ a paradigm of conflictual dissonance, elicited by viewing emotional faces with contradictory emotional words written across them—e.g., a frightened face and the word "happy" across it.

[14] Concepts of ego have undergone changes within the broad conflict-ego psychology psychoanalytic group, starting with Freud (1923) and extended by Rapaport & Gill (1959). The changing concepts of ego continued with Hartmann, Kris,& Loewenstein (1964), Hartmann (1964), and Arlow & Brenner (1964). Brenner (2002) recently proposed dispensing with the concept of ego entirely, seeing it as clinically unusable. He favored formulating mental and emotional expressions solely in terms of conflict, about which he had written productively for five decades. This view has been very controversial.

executive may coincide with the self, which is also not defined in the article. There are many concepts of self among the various analytic groups.[15] There is a small but growing body of fMRI literature that is pursuing research on self-related experiences. These studies show activations of a large number of *medial* prefrontal, limbic, paralimbic, temporal, and parietal areas that correlate with self-related experiences (Kelley et al., 2002; Northoff et al., 2006, 2009). The only medial area shown in this article's findings, which is also activated during various self-related paradigms, is the rostral anterior cingulate gyrus BA 32. As discussed below, TFA is partly an interpersonal, self–other dialogue. For demonstrations of self-related and other-related activations in neuroimaging studies, see Ochsner et al. **(**2004) and Jardri et al. (2007).

It would be useful to find working definitions for the two types of free association, VFA and TFA, and try to delineate their similarities and differences. The article helpfully, implicitly, suggests that three general criteria of VFA are *simple* forms of spontaneity, thematic confluence, and affective expressiveness. More *complex* forms of these three features also seem to characterize a significant part of TFA. Writing about psychoanalytic TFA, Kris (1996) suggests that some of its central features are spontaneity, comprehensibility, continuity, and the subject's pleasure (satisfaction) in meaningfully associating freely. He also presents other complex features of psychoanalytic free association: the emergence of various interrelated components of emotional conflict (Brenner, 1982; Freud, 1926; Kris, 1996); the appearance of associated memories, some of which seem to recall formative influences; transference expressions, related to the therapist or overall analytic setting; and free exchanges back and forth between the analyst and patient, often about the three features just mentioned (Kris, 1996). On the other hand, Kris states that there are constraints on free association due to reluctance, resistance, or negativity. Moreover, he notes that psychoanalytic free association is interwoven with analyst interventions and patient self-reflections (Kris, 1996; Waldron et al., 2004b), and he emphasizes, as does Loewenstein (1963) and Busch (1995), that free association is an inseparable part of the psychoanalytic treatment *process,* comprised of complex collaborative interactions between the patient and the therapist.

Therapeutic free association only occurs in the context of a specially constructed psychoanalytic treatment situation (Stone, 1961). The psychoanalytic treatment process and free association inherently require the patient's intention to seek help for emotional and sometimes physical problems and to apply his or her increased emotional understanding to alter cognition and affective and behavioral expressions. The patient associates, with the intention of understanding her/himself and increasing the therapist's knowledge, and at times self-reflects about her/his associations to further increase personal insight. The process includes the therapist's dedication to use her/his psychological and physiological knowledge and, hopefully, better emotional health on the patient's behalf. The therapist listens carefully and responsively intervenes with requests for elaboration, clarification, interpretation, and support, and fairly rapid exchanges between the two may occur. A lively, shifting entity of psychoanalytic process emerges with runs of what might be called a mixture of the basic and complex features of TFA, punctuated by temporary or prolonged interferences due to conflict, problematic structuring arising during development, transference, issues of low self-esteem, negativism, and other kind of resistance.

The Analytic Process Scales (APS)[16] contain scales of patient and therapist variables, designed to measure the back-and-forth flow of interactions between patient and therapist in the serial segments of consecutive, audiorecorded, psychoanalytic sessions. The patient portion of the scales includes many variables that seem to measure free association, and these overlap with many of the ones mentioned by Kris. It additionally includes issues of self-esteem and an awareness of personal emotional problems (Scharf et al., 1999).

Restating, I hypothesize that the three central criteria of VFA are *simple*: spontaneity, general thematic coherence, and general affective expressiveness.

I hypothesize that ten central features of TFA are *complex* forms of (1) spontaneity; (2) affective expressiveness; (3) emotional theme coherence; (4) narratives of episodes of immediately lived experience;[17] (5) expressions of emotional conflicts *or* unfavorable psychological structuring; (6) memories, fantasies, or

[15] Concepts of self include phenomenological self-experience; the whole person, body and mind (Hartmann, 1964); and all aspects of the individual from the viewpoint of the subject (Kohut, 1971). There are also related concepts of "narcissism," which seem to capture ideas about a group of individuals who show oversized self-centered feelings, outlooks, or behaviors and tend to feel entitled, superior, or self-exalted—as well leaning toward the devaluation and dismissal of others (Kernberg, 1975).

[16] The Analytic Process Scales were developed by the Analytic Process Scales Group chaired by Sherwood Waldron, Jr. over a period of 14 years (Waldron et al., 2004a).

[17] These are narratives of immediately lived episodes of current, past, or transference experiences.

dreams; (7) experiences of the therapist or overall treatment situation; (8) self-esteem issues; (9) awareness of the subject's own emotional problems; and (10) at times, free exchanges between analyst and patient. These features of psychoanalytic TFA can be confirmed, negated, or amended by examination of session data, particularly complete audiorecordings of series of consecutive analytic sessions.

The term "psychoanalytic free association" tends to bring to mind spontaneous runs of a basic form of therapeutic free association, and usually not the more complex features of free association, which are always dynamically interspersed with emotional conflict and other impeding features mentioned above. The result is an elusive ebb and flow of a complex treatment process, making a potential construction of a paradigm for psychoanalytic TFA quite difficult.

A way of approaching the dilemma may be to study a series of recorded sessions of multiple patient–analyst psychoanalyses, examining the "real-time" psychoanalytic microprocesses.[18] Starting with the ten aspects mentioned above, they can be psychologically assessed for the most relevant aspects of free association and how they might be modeled in a TFA fMRI paradigm. The identified specific features of TFA activities could be verbally defined and psychometrically delineated. It may be feasible to scale some categories of TFA on five-point Likert-like scales, scored 0–4, and assess their scoring reliability and validity.[19] It might then be possible to devise a paradigm that more meaningfully models some of these categories of free association.

In a considerably simplified model of the psychoanalytic treatment process that capsulizes the writings of W. Bucci, a well-working treatment process approximates the trajectory of a sine-wave curve. On the positive side of the wave, the patient conveys experiences that are rich in immediately lived episodes of recent *or* past experiences, *or* of the analyst or overall analytic situation. These are *high* in "referential activity" (RA) (Bucci, 1997b) and "emotional words" (EW) (Mergenthaler & Bucci, 1999).[20] Referential activity is a term introduced by Bucci to denote verbal expressions that translate presymbolic, or subsymbolic, coding formations associated with the affective "self," "other," and "self–other relationships into more advanced secondary–process iconic, narrative, metaphoric, or metonymic reasonably logical, relatively linear coding.[21] The negative side of the wave continues with patient self-reflections or analyst interventions, which are suitable abstract generalizations, *low* in RA and high in abstract words (AW). They are followed by more conveyed experiences, and more self-reflection or analyst intervention, and so on, with sine-like alternations (Bucci, 1997a, 1997b).

Patient's vocalized free associations, high in episodes of immediately lived experience, are potentially very productive in transformational improvements in the patient's emotional health and maturation (Angus & McLeod, 2003; Boston Change Process Study Group, 2007; Scharf et al., 1999). When the patient's vocalized self-reflections, or comprehension of analyst interventions, are *aptly* joined with vocalizations of immediately lived experience episodes, the conjoined result becomes more potentially mutative than vocalized experiences alone. On the other hand, vocalized abstract self-reflections or comprehended analyst interventions, which are unattached to immediate lived patient experiences, are, in Bucci's terms, high in AW and low in RA and tend to have little positive impact. They will often serve to defensively dampen down the psychoanalytic process. When a patient delivers a long series of these kinds of intellectualizations, following his or her stylistic and defensive needs, and even if the generalizations are relevant and accurate, they usually fail to move the analytic treatment process forward.

I believe it is important to study TFA to further psychoanalytic psychological, and neural, understanding of thought, language, and consciousness. Bucci 1997b hypothesizes that free association is a means of bringing presymbolic or subsymbolic, nonlinearly coded, mental formations, which exist in a low-level conscious or nonconscious state, into various kinds of secondary, linguistically coded formations that are conscious (Bucci, 1997b). I further hypothesize that free association is a means of joining together *conscious,* well-coded, yet defensively disconnected formations,

[18] About two dozen completely recorded psychoanalyses are stored by the Psychoanalytic Research Consortium in New York, and additional cases, in German, are in the Ulm text bank.

[19] The resulting categories of psychoanalytic TFA might be standardized in a broader group of subjects to better establish their general reliability and wider external validity.

[20] Emotional words and abstract words are rated by word dictionaries developed by E. Mergenthaler.

[21] RA was originally rated by trained scorers (human RA) and is now generated by a third-generation computer program, using an extensive word library, which is applied to digitally prepared entire sessions or other data. Bucci and Maskit have continued to elaborate this work in an extensive line of research.

which increases their level of perceived meaning and consciousness.

Among the psychotherapies, only psychoanalysis with its "indirect" quasi-linear free-association method can help a patient and therapist obtain the data needed to treat problems of some linguistically and, generally, reasonably well-organized persons. These patients are also considerably emotionally and linguistically organized by interfering regressive repetitive emotional conflicts, with their related fantasies, and developmentally derived psychological structural problems, and their related fantasies. The patients tend to endlessly repeat inhibitions or disinhibitions of narratively symbolically, or presymbolically, organized conflicted impulses, thoughts, feelings, moods, and behaviors. The psychoanalytic method, centering on free association, generates sufficiently extensive conscious or implicit understandings of the micropsychological workings of these repeating problems to facilitate progressive and transmuting shifts, toward durable changes, including symptomatic and psychological structural remediation. The cognitive and emotional, and brain, mechanisms involved in these changes are just starting to be understood.

Developing a series of extremely uncertain speculations, I also hypothesize that the more a mental process is unconscious, the more that corresponding subcortical, paralimbic, and perhaps secondary sensory association, cognition, and vocalization areas, and their processing, are activated. Free association can be conjectured to bring corresponding subcortically, and secondary cortically, organized pre- and subsymbolically coded mental formations more into conscious awareness. The entrance of a mental formation into conscious awareness seems to create a familiar, but significant, change in its state, which carries with it more possibility of reorganization and a shift toward emotional health. Conversely, I would tentatively hypothesize that emotional and mental structural regressions, noted by Freud (1926) and Jackson (1888–89),[22] are accompanied by increases in activity in subcortical, paralimbic, and perhaps secondary cortical areas, which may eventually be demonstrable by fMRI studies, perhaps at 7 Tessla.

Evolution has progressed by the expansion, elaboration, and change of functions of existing brain areas. In the course of the evolution of the brain from a therapsid reptile brain into the paleomammalian, later mammalian, primate, and human brain, highly complex dorsal areas with a very oversized PFC have developed, including the DLPFC and an extremely oversized rAPFC. At the same time, the seemingly "new" formation of the cingulate cortex, the thin, rudimentary, paralimbic cortices,[23] and the semi-archaic mixed "cortical" and "nuclear" areas of the limbic structures—the amygdala/extended amygdala and hippocampal/parahippocampal complexes—also developed. But the subcortical areas have remained comparatively much more primitive than the neocortical areas (MacLean, 1990; Sanides, 1969). As a result of a seeming evolutional disparity between the processing in highly complex dorsal neocortical structures, and the processing in the advanced but still much more primitive ventral structures, integration of the two kinds of processing may have remained unwieldy. Stated differently, the coding in the higher neocortical, cognitive, attention, memory, and verbal and other motor networks, and the coding in the *basic* subcortical drive, affect, mood, primitive self, and elemental attachment/relational networks, may be disparate. The two kinds of coding may be integrated by means of special kinds of coding strategies and translations, different from those with which the dorsal networks interrelate with one another.

Following Bucci (1997b), I further speculate that free association may foster an integration and translation of less symbolic, less conscious coding of mental-event processing into a more symbolic, more conscious coding of the processing of mental events. I also hypothesize that one of the highest levels of consciousness will be found to be a state with exceptional widespread momentary associativeness, including associations of related intense affects, and that psychoanalytic free association strives to approximate this very condition. It may be that examining free association would be helpful in studying the mental and corresponding neural aspects of consciousness, as well as showing us more about possible psychoanalytic treatment strategies. These hypotheses might be tested by studying the various kinds of complex features of psychoanalytic free association and by developing paradigms that model their characteristics.

[22] John Hughlings Jackson suggested that the brain is stratified, with the lower levels less flexible and less vulnerable, and the higher levels more flexible and more vulnerable. The highest level, presumably organized by the rostral anterior prefrontal regions, seems to be the most flexible level, and the one most vulnerable to even minor brain trauma (Jackson, 1887). With trauma or psychosis, dissolution and reorganization (regression) in brain functioning occurs (Jackson, 1888–89).

[23] The paralimbic cortex tends to have three layers, rather than the six layers of the neocortex.

REFERENCES

Abend, S. M., Porder, M. S., & Willick, M. (1983). *Borderline Patients: Psychoanalytic Perspectives.* New York: International Universities Press.

Angus, L. E., & McLeod, J. (Eds.) (2003). *The Handbook of Narrative and Psychotherapy: Practice, Theory, and Research*. London: Sage.

Arlow, J. A., & Brenner, C. (1964). *Psychoanalytic Concepts and the Structural Theory*. New York: International Universities Press.

Bellak, L., & Meyers, B. (1975). Ego function assessment and analysability. *International Review of Psychoanalysis,* 2: 413–442.

Boston Change Process Study Group (2007). The foundational level of psychodynamic meaning: Implicit process in relation to conflict, defense and the dynamic unconscious. *International Journal of Psychoanalysis,* 88: 1–16.

Braak, H., Braak, E., Yilmazer, D., & Bohl, J. (1996). Functional anatomy of human hippocampal formation and related structures. *Journal of Child Neurology,* 11 (4): 265–275.

Brenner, C. (1982). *The Mind in Conflict*. Madison, CT: International Universities Press.

Brenner, C. (2002). Conflict, compromise formation, and structural theory. *Psychoanalytic Quarterly,* 71 (3): 397–417.

Bucci, W. (1997a). Patterns of discourse in "good" and troubled hours: A multiple code interpretation. *Journal of the American Psychoanalytic Association,* 45 (1): 155–187.

Bucci, W. (1997b). *Psychoanalysis and Cognitive Science: A Multiple Code Theory*. New York: Guilford Press.

Busch, F. (1995). Beginning a psychoanalytic treatment: Establishing an analytic frame. *Journal of the American Psychoanalytic Association,* 43 (2): 449–468.

Cassell (1978). *Cassell's German Dictionary.* New York: Macmillan.

Drevets, W. C. (2007). Orbitofrontal cortex function and structure in depression. *Annals of the New York Academy of Sciences,* 1121: 499–527.

Ellenberger, H. F. (1970). *The Discovery of the Unconscious: The History and Evolution of Dynamic Psychiatry*. London: Fontana Press.

Etkin, A., Egner, T., Peraza, D. M., Kandel, E. R., & Hirsch, J. (2006). Resolving emotional conflict: A role for the rostral anterior cingulate cortex in modulating activity in the amygdala. *Neuron,* 51 (6): 871–882.

Freud, S. (1909). Notes upon a case of obsessional neurosis. *Standard Edition, 10*: 153–318.

Freud, S. (1923). *The Ego and the Id*. *Standard Edition*, 19.

Freud, S. (1926). *Inhibitions, Symptoms, and Anxiety*. *Standard Edition,* 20: 75–176.

Freud, S. (1940 [1938]). *An Outline of Psycho-Analysis*. *Standard Edition, 23.*

Galton, F. (1879). Psychometric experiments. *Brain,* 2: 149–162.

Gilbert, S. J., Spengler, S., Simons, J. S., Steele, J. D., Lawrie, S. M., Frith, C. D., et al. (2006). Functional specialization within rostral prefrontal cortex (area 10): A meta-analysis. *Journal of Cognitive Neuroscience,* 18 (6): 932–948.

Gilbert, S. J., Williamson, I. D., Dumontheil, I., Simons, J. S., Frith, C. D., & Burgess, P. W. (2007). Distinct regions of medial rostral prefrontal cortex supporting social and nonsocial functions. *Social Cognitive and Affective Neuroscience,* 2 (3): 217–226.

Gracco, V. L., Tremblay, P., & Pike, B. (2005). Imaging speech production using fMRI. *NeuroImage,* 26 (1): 294–301.

Grimm, S. C., Schmidt, F., Bermpohl, F., Heinzel, A., Dahlem, Y., Wyss, M., et al. (2006). Segregated neural representation of distinct emotion dimensions in the prefrontal cortex—an fMRI study. *NeuroImage,* 30 (1): 325–340.

Hartmann, H. (1964). *Essays on Ego Psychology: Selected Problems in Psychoanalytic Theory*. New York: International Universities Press.

Hartmann, H., Kris, E., & Loewenstein, R. M. (1964). Papers on psychoanalytic psychology. *Psychological Issues,* 68: 14:1–206.

Jackson, J. H. (1887). Remarks on evolution and dissolution of the nervous system. In: *Selected Writings of John Hughlings Jackson*, ed. J. Taylor. New York: Basic Books, 1958, pp. 92–102.

Jackson, J. H. (1888–89). *On Post-epileptic States: A Contribution to the Comparative Study of Insanities.* New York: Basic Books, 1958.

Jardri, R., Pins, D., Bubrovszky, M., Despretz, P., Pruvo, J. P., Steinling, M., et al. (2007). Self awareness and speech processing: An fMRI study. *NeuroImage,* 35 (4): 1645–1653.

Johnstone, T., van Reekum, C. M., Urry, H. L., Kalin, N. H., & Davidson, R. J. (2007). Failure to regulate: Counterproductive recruitment of top-down prefrontal-subcortical circuitry in major depression. *Journal of Neuroscience,* 27 (33): 8877–8884.

Kelley, W. M., C. N. Macrae, Wyland, C. L., Caglar, S., Inati, S., & Heatherton, T. F. (2002). Finding the self? An event-related fMRI study. *Journal of Cognitive Neuroscience,* 14 (5): 785–794.

Kernberg, O. F. (1975). *Borderline Conditions and Pathological Narcissism.* New York: Jason Aronson.

Kohut, H. (1971). *The Analysis of the Self: A Systematic Approach to the Psychoanalytic Treatment of Narcissistic Personality Disorders.* New York: International Universities Press.

Kris, A. O. (1996). *Free Association: Method and Process* (revised edition). London: Karnac; Hillsdale, NJ: Analytic Press.

Livingstone Smith, D. (2004). *Why We Lie: The Evolutionary Roots of Deception and the Unconscious Mind*. New York: St Martin's Press.

Loewenstein, R. M. (1963). Some considerations on free association. *Journal of the American Psychoanalytic Association,* 11: 451–473.

Luria, A. R. (1973). *The Working Brain: An Introduction to Neuropsychology.* London: Penguin Books.

MacLean, P. D. (1990). *The Triune Brain in Evolution: Role in Paleocerebral Function.* New York: Plenum Press.

Mergenthaler, E., & Bucci, W. (1999). Linking verbal and non-verbal representations: Computer analysis of referential

activity." *British Journal of Medical Psychology,* 72 (Pt 3): 339–354.
Mesulam, M. M. (2000). *Principles of Behavioral and Cognitive Neurology* (2nd edition). New York: Oxford University Press.
Moll, J., Zahn, R., Oliveira-Souza, R. de, Krueger, F., & Grafman, J. (2005). Opinion: The neural basis of human moral cognition." *Nature Reviews. Neuroscience,* 6 (10): 799–809.
Northoff, G., Heinzel, A., de Greck, M., Bermpohl, F., Dobrowolny, H., & Panksepp, J. (2006). Self-referential processing in our brain—a meta-analysis of imaging studies on the self. *NeuroImage,* 31 (1): 440–457.
Northoff, G., Schneider, F., Rotte, M., Matthiae, C., Tempelmann, C., Wiebking, C., et al. (2009). Differential parametric modulation of self-relatedness and emotions in different brain regions. *Human Brain Mapping,* 30 (2): 369–382.
Ochsner, K. N., Knierim, K., Ludlow, D. H., Hanelin, J., Ramachandran, T., Glover, G., et al. (2004). Reflecting upon feelings: An fMRI study of neural systems supporting the attribution of emotion to self and other. *Journal of Cognitive Neuroscience,* 16 (10): 1746–1772.
Rapaport, D., & Gill, M. M. (1959). The points of view and assumptions of metapsychology. *International Journal of Psychoanalysis,* 40: 153–162.
Rosser, A., & Hodges, J. R. (1994). Initial letter and semantic category fluency in Alzheimer's disease, Huntington's disease, and progressive supranuclear palsy. *Journal of Neurology, Neurosurgery, and Psychiatry,* 57 (11): 1389–1394.
Sanides, F. (1969). Comparative architectonics of the neo cortex of mammals and their evolutionary interpretation. *Annals of the New York Academy of Sciences,* 167.
Scharf, R. D., Waldron, S., Firestein, S. K., Goldberger, M., & Burton A. (1999). *The Analytic Process Scales (APS), Coding Manual*. Retrieved 6 November 2009 from www.ipa.org.uk/research/pdf/waldron2_odr.pdf).
Spacal, S. (1990). Free association as a method of self-observation in relation to other methodological principles of psychoanalysis. *Psychoanalytic Quarterly,* 59 (3): 420–436.
Stone, L. (1961). *The Psychoanalytic Situation*. New York: International Universities Press.
Turner, M. S., Simons, J. S., Gilbert, S. J., Frith, C. D., & Burgess, P. W. (2008). Distinct roles for lateral and medial rostral prefrontal cortex in source monitoring of perceived and imagined events. *Neuropsychologia,* 46 (5): 1442–1453.
Waldron, S., Scharf, R. D., Hurst, D., Firestein, S. K., & Burton, A. (2004a). What happens in a psychoanalysis: A view through the lens of the analytic process scales (APS). *International Journal of Psychoanalysis,* 85 (2): 443–446.
Waldron, S., Scharf, R. D., Crouse, J., Firestein, S. K., Burton, A., & Hurst, D. (2004b). Saying the right thing at the right time: A view through the lens of the analytic process scales (APS). *Psychoanalytic Quarterly,* 73 (4): 1079–1125.

Response to Commentaries

Sean A. Spence

First of all, we should like to acknowledge our gratitude to Ariane Bazan, Andrew Gerber, and Robert Scharf for their detailed and thought-provoking comments and also for their preparedness to engage in discussion of a cognitive neurobiological approach to free association. To advance this field—to facilitate the collaborative discourse envisaged by Piaget (see our target article)—requires that practitioners from a variety of disciplines be receptive to the possibility of an open, interdisciplinary discussion of complex mental phenomena (which may themselves have attracted varying descriptive labels across different literatures). Certainly, this has been our starting point with respect to free association, which we see as an example of a quintessentially "executive" process, albeit one that is utilized for therapeutic ends during the course of the psychoanalytic encounter.

The issues raised by Bazan, Gerber, and Scharf are all well taken, and here we touch solely upon those points of confluence that may point the way to future empirical work in this area.

To begin with, Bazan rightly directs us to a careful consideration of what we mean by "free" association and those attributes that define the process as it is currently practiced. An interesting distinction that arises is one that we also identified in our article— namely, that between a "free association" that is discursive or generative in nature, elaborating novel responses within a given environment, and that which is relatively automatic and, hence, "routine." We might hypothesize that the former is a freedom reflecting enhanced executive control (a putatively "positive" freedom, implicating the psychodynamic "ego") while the latter reflects a "freedom" emerging when executive control is somewhat diminished and the speaker is "free" to resort to more stereotypic response routines (a kind of "negative" freedom, which Bazan identifies as revealing the "repressed"). Which is the more authentic? Which is the more "free"? From what we have reported in our article, and in keeping with Bazan's analysis, we may hypothesize that the generative, executive freedom, exemplified by thematic elaboration, may be more a feature of the early analytic process (and indicative of defense/repression/resistance), while the less guarded (less defended/repressed/resisted), more habitual utterances of the latter category arise more often in later stages of such a process. In each of the commentaries on our article, it is clear that the authors attribute significance to these latter utterances: hence, what may be construed as relatively stereotypic or computationally "redundant" in the language of cognitive science need not be devoid of value or "meaning" in a therapeutic, hermeneutic setting, since it is the ingrained nature of such recurrent response patterns that may constitute the subject's symptomatology (at some level). Thus, Bazan refers to the possibility that such response patterns may "reveal the idiosyncrasies of the architecture of the subject's mental apparatus."

Hence, we might propose a further line of empirical enquiry that seeks to understand just how the cognitive language of "novelty versus stereotypy" maps onto the psychodynamic concepts of "defense/repression versus authenticity/the repressed." We are at the beginning of such a science. However, what each of our commentators seems to acknowledge (notwithstanding the qualifications noted by Scharf) is that there is a resemblance between the executive control of free association (occurring "early" on in the associative process, as practiced in the scanning environment) and the attributes of a Freudian "ego." While we cannot claim to have "mapped" the latter construct, we posit that we have demonstrated some of those brain systems that support its function.

Gerber has provided an overview of the functional neuroimaging literature as applied to the psychotherapies and has pointed to the finding that prefrontal/executive activity may decrease as a corollary of various forms of therapeutic intervention. One way of understanding such data is to hypothesize that they reflect a reduction in executive control/defense/repression/resistance, as those exposed to therapy engage with the therapeutic process. Hence, patients may be posited to become less defended, less guarded, as therapies progress. Nevertheless, Gerber points out that studies in this area have tended be rather small, scanning subjects on two occasions at most, thereby precluding any detailed consideration of the long-term effects of therapy. However, this is a shortcoming that may be straightforwardly addressed in future studies: one great advantage of functional magnetic resonance imaging (fMRI), in contrast to those imaging methodologies that utilize ionizing radiation (e.g., positron emission tomography, PET) is that the procedure may be safely repeated over time. Hence, it would be eminently feasible to study cohorts of patients engaged in varied forms of psychotherapy and to follow them up over the course of their treatments. Of course, such studies would likely require the continued collaboration of psychotherapists and cognitive neuroscientists.

Further empirical advances are advocated in Scharf's commentary. He rightly stresses the distinctions between our experimental "vocal free association" paradigm and the much more complex processes characterizing "therapeutic free association" in the clinic. He also notes that we have not focused on affective processes in our approach to free association, and that this is an omission deserving of further attention. While our approach has been very much focused on the procedural aspects of the associative process, it is true that greater attention might be paid to the emotional content of the emergent material. I suspect that we should require very much larger samples of subjects to pursue such a line of enquiry, in order for studies to be sufficiently statistically powered to detect emergent affective phenomena across groups of participating individuals, but there is no scientific reason why such studies should not proceed. Again, Scharf is correct that rating scales might be applied, both to ongoing therapeutic interventions and to aspects of the speech occurring within the scanning environment. There is still plenty of space for empirical ingenuity in this emerging field.

Once again, we are very grateful to the commentators for their remarks and we hope that this study may prompt further investigation of the cognitive neurobiological architectures that support psychodynamic and psychotherapeutic processes.