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Alpha synchronization as a brain model for unconscious defense: An overview of the work of Howard Shevrin and his team

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Howard Shevrin and his team have developed a stringent subliminal priming methodology, which experimentally approximates a situation of an internal, mental triggering of unconscious defense. Through a series of four studies they thus are able to bring evidence for this type of unconscious defense. With event-related potentials, three clinical studies show how synchronization of a specific brain wave, the alpha wave, known for its inhibitory function, is also induced by subliminally presented conflictual subject-specific stimuli. Therefore, alpha synchronization could serve as the brain mechanism of unconscious defense. The results only make sense if we suppose the existence of a dynamic unconscious, which has inherited childhood conflicts, and with privileged connections to neurotic symptom characteristics. Moreover, by showing that the unconscious conflict phrases, inferred by clinicians from clinical interviews, have a similar brain behavior, Shevrin and his team provide evidence that these inferences are not simply clinician-dependent subjective interpretations but also imply some form of independent mental reality. Finally, interpretation of the results has led us to propose two distinct physiological mechanisms for defense: one, unconscious defense, by alpha synchronization in connection with the drive derivatives, and another, repression, based on the indications of reality in connection with the ego.

Keywords: unconscious, defense, Shevrin, brain, alpha, subliminal, repression, Freud, empirical

This paper proposes an overview of a series of four studies, all originating from the 'Ormond and Hazel Hunt Laboratory for the Study of Conscious and Unconscious Processes', directed by the psychoanalyst and neuroscience researcher, Howard Shevrin at the University of Michigan in Ann Arbor.[1] With the help of his collaborators, Michael Snodgrass, Linda Brakel, Ramesh Kushwaha, and others, Howard Shevrin has developed a unique experimental paradigm, called 'subliminal priming at the objective detection threshold' (see below), which involves a very stringent form of subliminal priming, whereby visual stimuli are presented for ultra-short durations – namely, one

[1]I was on this team for the two last studies while I was doing a postdoctoral fellowship at the laboratory from January 2003 until August 2005. I will from now on take the liberty to use the handle 'Shevrin lab', which stands for the 'Ormond and Hazel Hunt Laboratory for the Study of Conscious and Unconscious Processes'.

millisecond, that is, one thousandth of a second. The idea is that at this short duration the stimulus is not recognized as coming from outside and, therefore, a situation of an *internal* activation of defenses is approximated experimentally. The purpose of this review then is (1) to give experimental arguments for the existence of unconscious defense initiated internally (i.e. independent of external perception); and (2) to propose a model for a neuroscientific understanding of this unconscious defense – namely the synchronization of a brain wave called 'alpha' which is also involved in conscious avoidance.[2]

Subliminal priming research

The priming paradigm presents a first stimulus, the prime, and measures its influence on a second stimulus, the target (Segal and Cofer, 1960). When the prime is shown below a certain threshold – or *limen* – related to consciousness, the priming is said to be *subliminal*. Subliminality for visual stimuli is obtained by reducing the presentation time.

There is subliminal *perception* when a stimulus is demonstrated to be invisible while still influencing thoughts, feelings, actions, learning or memory. A body of research with the subliminal priming technique has been done both in psychodynamic and in cognitive laboratories (for an overview, see Kouider and Dehaene, 2007). These researches yield the most convincing results up to now inducing even the most severe critics of psychoanalysis to admit to the existence of unconscious processes (e.g. Kihlstrom, 1987; Greenwald, 1992; Kihlstrom *et al*., 1992; Rofe, 2008), which, albeit not qualified as psychodynamic, are nevertheless surprisingly intelligent, active and dynamic, displaying affective (e.g. Banse, 1999), lexical/semantic (Marcel, 1983a, 1983b; Cheesman and Merikle, 1984; Dell'Acqua and Grainger, 1999; Dehaene *et al*., 2001; Devlin *et al*., 2004; Nakamura *et al*., 2005; Naccache *et al*., 2005; Kiefer and Brendel, 2006), arithmetic (Dehaene *et al*., 1998; Naccache and Dehaene, 2001) and decisional abilities (Custers and Aarts, 2010) among others (cf. the 'New Unconscious', Hassin *et al*., 2005).

The subliminal priming research, which more directly pertains to psychoanalysis, mainly concerns two domains, in addition to the Shevrin research, namely subliminal psychodynamic activation (SPA) and mindset priming. We will first briefly summarize this body of research in light of its similarities and differences with the Shevrin lab research. In the SPA method (Silverman, 1967, 1976, 1983), subjects are exposed to repeated presentations of subliminal stimuli designed to either intensify unconscious conflicts or to gratify unconscious fantasies and wishes. In typical SPA experiments, the sentence 'MOMMY AND I ARE ONE' is presented repeatedly for 4 ms during one or several therapeutic sessions. The priming effects are assessed on clinical and non-clinical populations using pre-post treatment difference scores. In 1990, Hardaway reviewed 56 SPA studies to the conclusion of a moderate but significant positive effect of the 'MOTHER AND I ARE

[2]The author does not pretend that these results have direct implications for psychoanalytic practice – rather, it may affect analysts' mindset to know that their practice draws upon a theory that is not only metapsychologically sound but also proves to be heuristically productive for neuroscience (see below, 'Mental reality and circularity').

ONE'-primes on therapeutic and educational outcomes; virtually identical results were reported in published and unpublished studies (see Weinberger, 1992). Banse and Imhoff (2011, p. 258) calculated that "2,237 more unpublished studies with zero-effects would be needed to attribute the overall effect to a publication bias for significant results". However, despite this, two drawbacks have hampered the potential impact of this research. First, as the priming uses whole sentences, the control issues are virtually unmanageable (see e.g. Fudin, 1987; Balay and Shevrin, 1988). But, even with appropriate control conditions, it remains difficult to prove that the effect is due to the fact that the message is tapping into an unconscious wish or fear, and not merely, for example, into the positive or negative tone of the phrase (see also Fudin, 2001, 2002). To address this problem, Silverman *et al.* (1976) exposed subjects to stimuli that were supposedly either psychodynamically relevant or irrelevant to the underlying unconscious conflicts. For example, for stutterers the specific messages were both anal ('conflict-relevant', e.g. 'GO SHIT') and aggressive ('conflict-irrelevant', e.g. 'DESTROY MOTHER'). For the most part, the results were in agreement with the conflict specificity hypothesis. However, the researchers did not include all measures in every population and, therefore, it is possible that any of these conflict-arousing messages could also have produced the same behavioral effects in a different clinical population. For example, the anal message 'GO SHIT' could have produced similar variations on the stuttering index in schizophrenics, but that was not measured (Malik, 1996). It should be noted that more recent follow-up studies with the 'MOMMY AND I ARE ONE'-prime have confirmed that the stimulus was able to produce persisting reductions in depression as well as other effects among students over a 2-week period (Sohlberg and Birgegard, 2003; Sohlberg *et al.*, 2003). The persistence of positive results over decades indicates that the effects of this priming are very probably real, even if control and interpretation issues, proper to the SPA research, may have limited a wider impact of these results on the scientific community at large.

Mindset priming attempts to activate a particular mindset that may then carry over to subsequent unrelated contexts, without participants being aware of or intentionally choosing this mode of thought (Gollwitzer *et al.*, 1990; Bargh and Chartrand, 1999; Fujita and Trope, 2014). In a subset of this mindset priming research, the primes are subliminally presented words; both mortality and attachment priming are relevant to psychoanalysis. In terror management mindset priming, subliminal primes, such as the word 'death', lead to more favorable evaluations of people who praised the subject's cultural worldview (Greenberg *et al.*, 1997; Arndt *et al.*, 1997). In other words, despite reporting no conscious awareness of the primes, those exposed to the 'death'-primes exhibited increased defense of the proper worldview (Greenberg *et al.*, 1990, 1997, 2001; Pyszczynski *et al.*, 2006; Hirschberger *et al.*, 2009). In attachment priming, priming of secure base words can temporarily enhance a person's attachment security (Mikulincer and Shaver, 2007). Primes are typically either the name of a supportive other (e.g. Baldwin, 1994; Mikulincer *et al.*, 2005; Admoni, 2006; Mikulincer and Shaver, 2007) or security-related words (e.g., 'caring', 'support',

'love'; Pierce and Lydon, 1998; Mikulincer and Shaver, 2001) and their effect has been measured upon a large number of outcomes including seeking emotional support (Pierce and Lydon, 1998), increased cognitive openness (Mikulincer and Arad, 1999), increased compassion, and altruistic and prosocial behavior (Mikulincer and Shaver, 2001; Mikulincer *et al*., 2005; Mikulincer and Shaver, 2007). In some ways attachment priming is the negative of mortality priming: while death reminders exacerbate negative reactions to out-groups, who symbolically threaten the faith in the proper cultural worldview (e.g. Arndt *et al*., 1997), secure base primes attenuate negative reactions to these out-groups (Mikulincer and Shaver, 2001).

Subliminality in the SPA research is obtained by reducing priming to 4 or 5 ms, while in mindset priming, subliminal primes are shown anywhere in between 10 ms (e.g. Mikulincer *et al*., 2001) and 30 ms (e.g. Hirschberger *et al*., 2010). We believe that only the SPA research methodology is comparable to the Shevrin lab priming at 1 ms. In the mindset priming research, the invisibility of the prime is determined by a *subjective* methodology, whereby participants are asked directly if they see something. This yields priming times from 10 ms and up (e.g. Arndt *et al*., 1997, p. 384). Snodgrass and co-authors (Snodgrass and Lepisto, 2007; Snodgrass *et al*., 2009), however, propose that this subliminal processing cannot exclude residual conscious perception, even if people cannot report it. Snodgrass and Shevrin (Snodgrass *et al*., 2004a, 2004b; Snodgrass and Shevrin, 2006) have therefore developed an *objective* methodology in which participants are obliged to make the best possible guess on the presence or absence of the prime (in a separate detection experiment). If in this forced choice situation, there is *a total lack of correlation* between the pattern of responses ('something' or 'nothing') given by the participant and the pattern of actual blank-or-stimulus presentations (stimulus absent or present), administered by the researcher, then conscious detection is objectively excluded (see the Appendix, 1). It turns out that to attain this, priming times have to be as low as 1 ms – this is substantially lower than the times determined by the subjective method. This kind of subliminal priming is at the so-called 'objective detection threshold' or ODT. It is using this ODT-methodology, that Shevrin and colleagues have shown that this kind of subliminal stimuli elicits electric brain response patterns with a true structure, comparable to the structure evoked by supraliminal stimuli, be it at a lesser amplitude (Shevrin and Fritzler, 1968; Shevrin, 1973; Wong *et al*., 1994, 1997, 2004; Bernat *et al*., 2001a, 2001b): these data are thus among the first observations objectifying deep unconscious processing of stimuli.

We propose that subjective methodology probably taps into unconscious processes, which merely differ quantitatively, rather than qualitatively, with conscious processes. For example, the Arndt *et al*. (1997) worldview defense results upon subliminal primes, are also obtained after the participant has written an essay on the emotions on the thought of one's own death. In Mikulincer *et al*. (2005), supraliminal enhancement of attachment security (asking people to consciously remember experiences of being cared for) had the same effects as subliminal priming on compassion and altruistic behavior. In their 2001 study, Arndt *et al*. find that an explicit mortality reminder increased worldview accessibility only after a delay, while subliminal death

primes did so immediately. The difference in timing is explained in terms of spreading activation: subliminal primes have direct access to spread activation to death thoughts while conscious mortality salience first elicits 'proximal defenses' before also accessing death thoughts (Arndt *et al.*, 2001; see 'Two defense dynamics'). The positive effect of secure base priming is also explained in terms of spreading activation: activation of the secure base words automatically spreads to new stimuli and will heighten their readiness to be positively appraised (Mikulincer *et al.*, 2001). The SPA research, on the other hand, only leads to results when the primes are presented subliminally (at 4 ms) and nothing comparable is found with supraliminal primes (see e.g. Bornstein, 1990).

Therefore, what we propose is that the subliminal mindset priming remains at a weakly conscious or preconscious level and does not interfere with 'deep unconscious processes' (see also Block, 2005, 2007); as will be argued later on (in the section entitled 'Two defense dynamics'), the crucial difference between the two is that at a weakly conscious or preconscious level, stimuli can still be identified as coming from outside, while at the deep unconscious level, there is a confusion between internal and external stimuli, with an inability to correctly detect what comes from outside. To understand the radical difference between mindset priming and the ultrashort priming of the SPA or of the Shevrin methodology, it is useful to consider a graphic SPA prime such as 'GO SHIT'. We propose that there is no thinkable way that the effect of this message could form a kind of continuum between unconscious and conscious priming. While unconsciously a gratifying effect is expected with some participants, to the slightest extent that the prime is detected as coming from outside, only the consensual and politically correct negative or aversive reaction will result in all participants – as, presumably, an efficient defense system will have neutralized any potential phantasmatic effect of the prime (see 'Two defense dynamics'). In contrast, when using more consensual primes, like 'support' or 'threat', a continuity between weak unconscious and conscious processing is quite thinkable. However, when detection is zero, as with the objective threshold methodology, it becomes possible to interfere with deep unconscious processes. In other words, only this methodology can reveal the truly 'scandalous' nature of the unconscious, which distinguishes the psychodynamic unconscious (quite radically) from other models of unconscious processing.

Snodgrass *et al.*'s 'pop-look'-studies: Behavioral results indicating unconscious avoidance

In this 1993 study by Snodgrass and colleagues, one of four words, known to the participants, is presented at one millisecond and the participant has to identify which of the four words is presented. Overall identification is not significantly different from chance (25%). However, participants are asked to use one of two strategies in order to identify the stimuli: in the *look* strategy, subjects are instructed to attend carefully to the visual field and look hard for any trace of the stimuli; in the *pop* strategy, subjects are invited to allow one of the four stimulus words to pop into their heads – to say whichever of the four words comes to mind. Following the completion of the two strategy

conditions, subjects are asked which of the two conditions they prefer: when it was popping participants are called *poppers*, and when it was looking *lookers*. The 1993 experiment was replicated both in the Shevrin lab (Snodgrass and Shevrin, 2006) and by Van Selst and Merikle (1993). The main consistent finding (see Table 1), then, is that poppers guess significantly more than by chance (i.e. more than 25% of the guesses are correct) in the pop condition ($p < .05$), while lookers did better than chance in the look condition ($p < .001$). Another curious finding is that lookers performed *significantly below chance* in the pop condition ($p < .001$; Snodgrass and Shevrin, 2006).

The facilitation results (i.e., more than chance level) show that the participants are informed on the identity of the prime even if there was no conscious detection. But the remarkable systematic *below chance* performances can only make sense if we suppose that in these cases the subjects have also been unconsciously informed of the prime, and have in a second time systematically rejected the choice (Snodgrass *et al*., 1993). The only way to understand this result is that "when utilizing the strategy congruent with their preference, perhaps participants unconsciously allow this activation to influence their response, elevating performance above chance. In contrast, when utilizing the incongruent strategy, such influences are *unconsciously rejected* and below-chance performance ensues" (Snodgrass and Shevrin, 2006, p. 63; italics added). The looker inhibition then "might reflect a simple form of *unconscious defense*... Along these lines, lookers consistently expressed a strong preference for activity and control, explaining that they disliked 'doing nothing' as the pop instructions required. Obliging lookers to relinquish conscious control with pop instructions might instantiate a mildly conflictual situation, producing inhibition, whereas more congenial look instructions would not, yielding facilitation" (Snodgrass and Shevrin, 2006, p. 63; italics added). In other words, these results only make sense if we assume the existence of unconscious inhibition in a psychodynamic interpretation.

The initial social phobia study: Event-related potential indicators for unconscious conflict

This first clinical study in a series of three is known in the Shevrin lab by the handle 'Clin1' (Shevrin, 1992; Shevrin *et al*., 1996). Eight phobics and three subjects suffering from pathological grief reactions served as participants. The

Table 1. Meta-analysis of the pooled data of the 'pop-look'-experiments (Snodgrass & Shevrin, 2006): 'poppers' facilitate slightly in the pop condition ($p < .05$), while 'lookers' do better than chance in the look condition ($p < .001$) and performed significantly below chance in the pop condition ($p < .001$).

Performance by Inference and Strategy—pooled data from the original and eurrent experiments		
	Strategy	
Preference	Pop	Look
Pop (n = 139)	25.74 (4.12)	24.71 (4.55)
Look (n = 105)	23.06 (3.64)	26.40 (3.59)

Standard deviations and n's are in parentheses. Mean performance is percentage correct (chance = 25). See text for significance levels.

subjects met DSMIV-TR criteria. A clinical team made up of three psychoanalysts and a dynamically oriented psychologist conducted the patient assessments. One of the psychoanalysts interviewed the participant and the psychologist administrated the Rorschach and the TAT. The interviews were unstructured dialogues in which the patient was given the opportunity to talk freely about his complaints, relationships (including the relationship to the interviewer) and early experiences. On the basis of the first two interviews and the test results, the clinicians selected two groups of words or brief phrases: the first group captured the patient's conscious symptom experience (i.e., phobia or grief; conscious symptom or CS words) and the second reflected the presumed underlying unconscious conflict (unconscious conflict or UC words).

The clinical judgments were made within the context of a psychoanalytic frame of reference based largely on the structural theory elaborated by Arlow and Brenner (1964) and Brenner (1982). It was assumed that the individual's verbal and nonverbal communications to the clinician were unconsciously organized and unconsciously, as well as consciously, meaningful. That is, within the subject's speech, an expert can find clues (Arlow, 1979) or unintended giveaways of central conflicts around which the subject has, unwittingly, organized thoughts, feelings, and behaviors in relation to highly significant other persons (e.g. parents, siblings). These conflicts are most often *unconscious conflicts* inherited from childhood, when drives are most directly confronted with reality. Following Brenner (1971), while drives are impersonal and general, drive-derivatives are specific and uniquely personal, since drive-related activities, whether libidinal or aggressive, are from birth influenced by experiential factors: the uniquely personal unconscious conflicts are thus directly connected to these drive-derivatives. Both drives and drive derivatives can be thought of as prompts to act (elements with somatic origins which make a demand "upon the mind for work"; Freud, 1915). As long as reality hasn't constrained these prompts to act, we have a form of consciousness, which Solms (2013, p. 13) calls affective or instinctual, characterized by hallucination and acting-out: "Hallucinatory wish-fulfillment – Freud's prototype of 'primary-process' thinking – is a conscious form of thinking, albeit a very primitive form." But this 'very primitive form' of hallucinatory consciousness might not be representational. In the shift from drive derivative to unconscious conflict there is confrontation with reality which constrains the prompts to act, thanks to the inhibitory capacities of the maturating ego: it is through the intervention of this inhibition that representational or thought activity emerges, the Freudian secondary process: "Wishful cathexis to the point of hallucination [and] complete generation of unpleasure which involves a complete expenditure of defence are described by us as *psychical primary processes*; by contrast, those processes which are only made possible by a good cathexis of the ego, and which represent a moderation of the foregoing, are described as *psychical secondary processes*"[3] (Freud, 1895, pp. 326–327).

[3]Note this also corresponds to the take of neuroscientist Jeannerod (1994, p. 201) on the matter, who says that when a goal of an action plan cannot be reached (e.g. due to some interfering inhibition), "the sustained discharge [of the neurons encoding the final wished-for configuration] would be interpreted centrally as a pure representational activity and give rise to mental imagery" (see also Bazan, 2013).

It is probable, as Freud (1911, p. 221) says, that this thinking, which is "an experimental kind of acting", which does not proceed to motor execution, "was originally unconscious". In other words, as the drives and drive derivatives, constituting the id, might be 'affectively conscious', the first conflict elements are 'representationally unconscious'. As these unconscious conflicts directly result from the tensions evoked by the drive-derivatives, they are considered the most proximal to the id – for some as a part of the id itself (e.g., Moore and Fine, 1990, p. 90) and for others as part of the ego (e.g. Solms, 2013). As to what confrontation causes conflict, Shevrin and colleagues (1996, p. 20) propose that a fantasy is felt to be unacceptable or ungratifiable insofar as the subject holds it to be a consequence of, or to lead to, one of several childhood situations of danger initially identified by Freud (1926) – loss of object, loss of object's love, castration anxiety, or loss of one's own self-regard.[4] Consistent with the pleasure principle, it is in attempting to avoid these dangers and their attendant unpleasurable affects (anxiety, depression, humiliation etc.), that the unconscious conflicts result in various compromise formations among the tripartite structural systems (Freud, 1923). From this perspective, a symptom such as a social phobia might be the outcome of a wish to exhibit oneself (id derivative), an inhibition of this wish so that it is not in consciousness or acted upon (ego defense), and a withdrawal from social situations so that the wish cannot be satisfied (superego punishment or deprivation).

Each judge rated all the words on how representative they were of the conscious symptom and unconscious conflict. The judges then met as a group to discuss their reasons for their word ratings. These discussions provided feedback the judges could then use in subsequent word ratings. Differences were aired and the interviewer instructed as to what new information to obtain in a third interview. After this last interview, there was a second word selection based on the transcripts, and again the judges rated their formulations. The judges met again as a group, and agreed on final formulations for each participant. Again, these were rated by the judges (fourth rating). The eight words best reflecting the conscious symptom and eight words best reflecting the unconscious conflict were chosen from among those in the top fourth of the final ranking (see Shevrin *et al.*, 1996, p. 139; and the Appendix, 2 for a detailed description of the word selection procedure).

These groups of words were presented six times both subliminally (1 ms) and supraliminally (40 ms) to each participant. The brain responses were derived from so-called 'event-related potentials': event-related potentials or ERPs are very small voltages generated in the brain in response to specific events or stimuli (Blackwood and Muir, 1990). They are thought to reflect the summed activity of a large number of

[4]And Shevrin *et al.* (1996, p. 20) go on to give the following illustrations of this: "Thus, if a boy wishes to kill his father in order to have a more intimate and exclusive relationship with his mother, this is unacceptable on several counts: he loves his father, killing is bad, his father may retaliate during an attack, and so on. If this same boy envies his mother's capacity to give birth and wishes to do so himself, this wish is ungratifiable owing to its impossibility, and humiliation may result from having had such an impossible wish."

synchronously firing cortical neurons (in the order of thousands or millions) while processing information (Peterson *et al.*, 1995): this activity can be picked up by metal electrodes, which are non-invasively glued to the scalp. In this study, Shevrin and team used a specific method (see Appendix, 3), which enabled them to measure instantaneous brain wave changes: this might be crucial as unconscious processing might yield changing patterns within brief time intervals.

The results showed that the brain waves, at a specific electrode location on the hind left part of the brain (i.e. left parietal region) revealed a significant pattern. The specific characteristics of the participant's ERPs were more similar for the unconscious conflict words when they were presented unconsciously (i.e. subliminally) than when they were presented consciously (i.e. supraliminally). At the same time, these very same ERP characteristics (i.e., same wave form parameters at the same hindbrain location) were more similar for the conscious symptom words when they were presented supraliminally than when presented subliminally. In simple words, while unconsciously, the UC words form a group on the basis of brain characteristics, consciously they do not; the reverse is true for the CS words (see Appendix, 4). Further, in the same experiment, it was also found that there was greater information flow (between pairs of electrodes) when the unconscious conflict words were presented subliminally as compared to supraliminally (Kushwaha *et al.*, 1992; see Appendix, 5). This directly contradicts the prevailing neurocognitive model (Dehaene *et al.*, 2006), which defines subliminal processing as characterized by the lack of a large-scale reverberating state in a global network of neurons, and for this very reason not reaching conscious access.

At difference with this model, the data suggest there is large-scale reverberation, but that the failure of the ERP features to classify the UC words correctly supraliminally, might point to defensive activity occurring when the words were conscious. This interpretation is strengthened by another result involving the Hysteroid-Obsessoid Questionnaire (HOQ; Caine and Hawkins, 1963; Caine and Hope, 1967), a personality questionnaire that is thought to provide a measure of the defensive organization, related to different patterns of defenses. Results showed that the more repressive the subject was on the HOQ, the better the ERP features correctly classified the UC words subliminally over supraliminally (Shevrin, 1992; Shevrin *et al.*, 1996; see Appendix, 6). Consistent with repression, these results on the UC words suggest that the 'hysteroid-repressive' subjects knew unconsciously what they had to remain unaware of consciously.

After the experiment, the participants were asked to classify all their words, written on pieces of paper, in as many categories as they wished: while the CS words were easily grouped together, the UC words were nowhere. To the participant's conscious experience these words did not form a category, let alone a category pertaining to the conflict underlying their symptoms. It was the clinicians who *inferred* from their conscious story that this group of words was indicative of the unconscious conflict underlying the conscious symptoms (see 'Mental reality and circularity').

The Spider Phobia study: Alpha synchronization as an unconscious defense mechanism against threat

This second clinical study in a series of three is known in the Shevrin lab by the handle 'Phobia' (see the poster abstract: Shevrin *et al.*, 2010); this study focuses on patients with a very specific phobia, namely spider phobia. Unlike in Clin1, stimuli are therefore not different for each participant, but the experimental stimuli are spider drawings for all participants.[5]

Brain activity, when the subject is 'at rest', typically fluctuates in wave-like patterns, reflecting the sum of a very large number of synchronously firing cortical neurons – analogous to what we have described above for an ERP signal. These ensembles of neurons fire at particular frequencies depending on their function and activity level. In this study, we focus on one frequency band, the alpha waves with wave oscillations of 8 to 13 cycles per second (i.e. 8 to 13 Hz). When many ensembles of neurons fire together at a particular frequency, the wave activity is *synchronized* and this is taken to indicate a high level of activity in that frequency band. Neural activity in the alpha range has been shown to reflect the state of awareness of an individual. As subjects begin to lose focus, increased amplitude of alpha oscillations is observed, with the largest alpha amplitude occurring when the subjects' eyes are closed. For many years it was thought that alpha only represented an idling process in the visual system (Pfurtscheller *et al.,* 1996) but research has shown that synchronized alpha plays an inhibitory role in withdrawing attention from a distracting stimulus (Kelly *et al.*, 2006) and in suppressing memory retrieval (Klimesch, 1996). For example, if light was presented to each eye and the subject was instructed to pay attention only to the left eye, alpha power[6] to the right eye increased significantly and is thought to inhibit attention to the right eye (Kelly *et al.*, 2006). In another example, during a visual memory task, participants are asked to ignore certain visual stimuli: as a result, alpha power increased over the side of the brain that would normally have treated these visual stimuli (Sauseng *et al.*, 2009). The authors concluded that increased alpha activity allowed for suppression of these stimuli. This is consistent with the observation that an inward shift of attention is typically accompanied by increases in alpha power at the back of the brain, where perceived stimuli are treated (e.g., Jensen *et al.*, 2002; Cooper *et al.*, 2003). More recently, Klimesch *et al.* (2011) have provided extensive cognitive neuroscience evidence that *alpha power represents a general inhibition mechanism across cortical areas* – that is, its inhibitory function can be applied to different tasks and stimuli determined by a variety of top-down influences such as expectations and intentions. For all these reasons, we hypothesized that alpha power is also indicating the inhibitory function in unconscious defense. Therefore, in Phobia, we measured stimulus-induced synchronization of alpha waves specifically.

[5]Because the study is not yet published in full length, discussion of this piece of research will be brief and general (the interested reader is referred to the upcoming publication: Snodgrass *et al.*, in preparation).

[6]Alpha power (or amplitude^2) is a measure of alpha synchronization.

Spider images were presented subliminally and supraliminally to spider phobics and snake phobics (Shevrin *et al*., 2010). Subjects rated their fear of spiders before and after the subliminal presentations. Next to alpha synchronization, we also measured a specific ERP component, that is, a single wave that appears at a precise time point after the prime, here, specifically, an early amplitude peaking at around 100 ms after stimulus presentation. This so-called N100 is known as an indicator of early attentional processes (Vogel and Luck, 2000).

The results (Shevrin *et al.,* 2010; Snodgrass *et al*., in preparation) showed that increased alpha power for the spider stimulus correlated with a smaller and a delayed N100 component upon subliminal spider presentation while decreasing alpha power for the spider was associated with a larger and speeded N100. This was, however, only the case in spider phobics (see Appendix, 7). In other words, the more the phobic stimulus was able to elicit an inhibitory alpha synchronization, the smaller the N100 attentional response to this stimulus and the later it came. These results reflect a diminished attention to the phobic spider stimulus in spider phobics with high alpha power. Indeed, increased alpha power in spider phobics also correlated with a below chance detection of spider stimuli in the detection task. The results demonstrate that alpha power goes far beyond inhibiting attention to cognitively irrelevant stimuli. Indeed, the stimulus is not irrelevant but an emotionally significant one (a feared spider) and instead of receiving the task to dismiss, the participant was asked to attend. Our data thus suggest that alpha synchronization is also associated with rapid, unconscious inhibition of attention to salient emotional cues eliciting conflictual responses. These are strong indications that alpha power may serve as an inhibitory brain mechanism of unconscious defense.

Furthermore, increased alpha power in spider phobics correlated with greater self-reported spider fear and with less reduction in spider fear after repeated subliminal exposure. This suggests that greater unconscious efforts at inhibition are associated with increased intensity of conscious phobic fear, and directly speaks to one of the main claims for psychoanalytic clinical work: by addressing the unconscious determinants of our fears and symptoms, relief and benefit is obtained for our conscious life.

The second social phobia study: Alpha synchronization as a brain model for conflict-induced unconscious defense

This third clinical study is known by the handle 'Clin2' (Shevrin *et al*., 2013) and is a direct follow-up on Clin1. Though there was evidence in Clin1 for an unconscious inhibitory effect elicited by the unconscious conflict words, presented subliminally, the experimental set-up did not allow for the demonstration of a cause-and-effect-relationship between unconscious conflict and conscious symptom experience. Would the inhibitory process triggered by the activation of unconscious conflict also lead to inhibition related to the conscious symptom experience? To be able to verify this experimentally, the original design of Clin1 was shifted to a priming model in which the unconscious conflict stimuli preceded the conscious symptom stimuli.

Table 2. Examples of stimuli words tailored specifically for one particular subject. In the crucial condition of the priming experiment, an Unconscious Conflict (UC) word serves as a subliminal prime, followed by a supraliminally presented Conscious Symptom (CS) word; Osgood Negative Valence (ON) words serves as control targets.

Unconscious Conflict	Conscious Symptom	Osgood Negative Valence
mad at dad	cold calling	air pollution
paddle me	public talks	atomic bomb
favorite son	voice shaking	earthquake
cut it off	seminars	non-believers
trouble maker	upset stomach	crying
stubborn	stuttering	noise
grandpa	parties	poison

The conscious symptom (CS) words were all drawn from answers to interview questions; the unconscious conflict (UC) words were drawn from the subject's interviews and test responses; the ON words were drawn from the end points of the Osgood evaluative dimension and have been judged to be unrelated to the CS and UC words. The word categories were balanced for length and frequency of usage.

Three–four hour taped diagnostic interviews were obtained from 10 subjects who met DSM IV-TR criteria for social phobia and transcribed for word selection. This procedure yielded 7 Unconscious Conflict (UC) and 7 Conscious Symptom (CS) words, selected individually for each participant (for an example, see Table 2). Every presentation consisted of two words, the prime and the target, presented 1000 ms apart. All primes were presented subliminally (1 ms) as well as supraliminally (30 ms), whereas the targets were always supraliminal. Participants were simply instructed to attend to the stimuli.

We found that subliminal unconscious conflict prime alpha positively predicted conscious symptom target alpha ($p < .05$), especially in the back of the brain (parietal region; $p < .01$). Also, when UC primes were supraliminal they did not predict CS target alpha. As for the conscious symptom primes, subliminal CS prime alpha did not predict CS target alpha (see Appendix, 8). In other words, only when the UC primes were subliminal did they significantly predict CS target alpha power while CS prime influence never occurs subliminally. These findings strengthen the interpretation of an unconscious meaning for the unconscious conflict primes unconsciously eliciting an inhibition, carried by the alpha synchronization on the consciously experienced conscious symptom targets.

In what follows now, we discuss a speculative model of alpha synchronization as a possible brain principle of unconscious defense and systematically consider our respective results in that light.

Discussion

The Alpha model

How alpha synchronization might realize defense

In 2011, Kyle Mathewson and co-workers published a paper with a remarkable title: '*Pulsed out of awareness*: EEG alpha oscillations represent a pulsed-inhibition of ongoing cortical processing' (italics added). The authors specifically propose that "alpha oscillations act as a pulsed-inhibition of neural processing":

> Inhibition is not constant, however, but is in fact pulsed … with periods of punctuate inhibition alternating with others of relatively intact processing …. When there is less synchronization, these inhibitory periods are random and signals processed in the area can stand out against the noise. However, when oscillations become highly synchronized, periods of inhibition occur simultaneously across the population of cells, drowning out any signal representation …. To portray the theory in a metaphor, we imagine the oscillatory activity in a processing area as a large crowd at a football stadium. When the individual fans cheer at random times, any loud person can be heard over the hum of the crowd (e.g., 'COLD BEER!'). However, when the same applause becomes synchronized in a unified cheer, brief periods of widespread sound drown out any other important sounds. Similarly, we propose that inhibition acts on sensory areas by synchronizing the oscillatory excitability cycles of neurons in those areas, drowning out incoming signals.
>
> (Mathewson *et al.*, 2011, p. 7)

Note that this mechanism is directed from elsewhere in the brain. Mathewson *et al.* (2011, p. 6), indeed, specify that when inhibition of some part of a visual element "is needed, *top-down* signals … control the level of alpha oscillations" (italics added). In other words, a locus of agency, separate from the cortical area processing the incoming signal is aiming alpha pulses to the crucial area so as to interrupt its further processing. Alpha synchronization thus appears from these descriptions as some kind of 'steerable fire hose', which the brain has at its disposal to disrupt further processing of a signal. Moreover, the authors add that "this inhibitory processing mode is common across many brain areas", making even an explicit comparison with the treatment of "sound or speech" (Mathewson *et al.*, 2011, p. 12; p. 8).

In Clin1 the ERP characteristics at a hindbrain (i.e. parietal) location classified the UC words better subliminally than supraliminally; in Phobia alpha synchronization upon subliminal spider presentation correlated with diminished spider detection in spider phobics; and in Clin2 (parietal) alpha synchronization in the subliminally presented unconscious conflict prime predicted alpha synchronization in the supraliminal conscious symptom targets. To make sense of these results, we will suppose that Howard Shevrin's main hypothesis is right: in those participants, for whom the crucial stimulus is potentially threatening from a psychodynamic point of view, there is a reaction upon the prime stimulus with enhanced alpha synchronization aimed at the cortical areas which would normally treat these stimuli. Concretely: in those participants for whom the UC words were an accurate psychodynamic interpretation, in those spider phobics to whom the spider drawing was a high threat, when the crucial stimulus appears, alpha synchronization is readily engaged and 'drowns out any signal representation'. We propose to understand this psychodynamically in that *it isolates the signal representation from being (further) integrated into associative networks.* In line with this, it has been reliably shown that during retrieval from long-term memory, the more semantically integrated the retrieved information is, the larger the alpha desynchronization (for review, see Klimesch, 2012, p. 608). Because desynchronization is a release from inhibition, this suggests

that what is inhibited on a mental level is precisely the 'semantic integration', which corresponds with an 'integration into associative networks'. In other words, psychodynamically, alpha synchronization prevents the signal representation *from acquiring a subjective meaning*.

A model of defense in agreement with structural theory

The difference between repression and 'classic cognitive' cases of alpha synchronization is that in the case of repression it is supposed that some stimulus represents a threat to the subject not because it is 'potentially interfering' in some technical way, but because we suppose that there is, independent of the unconscious conflict *words*, an unconscious conflict *proper*. It is important not to stir up that conflict because it has high existential stakes for the subject since it is fueled by the drive derivatives and therefore, it has a high capacity to prompt the subject to act. Experience teaches us that any action induced by these prompts will have a very high probability of increasing unpleasure (and a low probability of effective discharge of the conflictual tension), and thus the prompts should be prevented from any progress in the direction of execution. The tension between both forces (prompts induced by the drive-derivatives and prevention of their progress towards execution) is at the heart of the conflict (Brenner, 1982). Stated as such, the alpha synchronization of our three case scenarios presented above, prevents further processing of the stimulus to attain the concerned drive-derivative, at the heart of the unconscious conflict. Logically, we would think that some minimal percolation from the prime stimulation to the internal conflict has come through (and is capable, or not, of inducing signal anxiety), and that this has elicited the ready activation of the alpha 'repression hose' towards the processing area in order to actively disrupt any further integration.[7] The cryptic 'if needed' (see above; Mathewson *et al.*, 2011, p. 6) could in the present context be understood as 'when the drive derivative has been slightly triggered', or 'when the drive-derivative is at a heightened risk of access to execution'. Perhaps then the drive-derivatives, or the unconscious conflict are to be considered as the locus of agency initiating or deciding the possible activation of the alpha hose – or alternatively, as proximal to this locus of agency.

In Clin2, the unconscious conflict words presented as subliminal primes induce alpha synchronization, and this alpha synchronization is proportional with the alpha synchronization induced by the subsequent conscious symptom words presented as supraliminal targets. The idea, then, is that the subliminal UC words have awakened the unconscious conflict and, even though this has resulted in the active neutralization of the further processing of the UC words, when the CS words arrive, these CS words might now constitute a threat to further stir up the already triggered unconscious conflict proper, with which, etiologically, they have privileged connections. For

[7]Here we see how different this model is from merely passive 'spreading activation' models (Neely, 1977; Anderson, 1983): even if these models assume competition and inhibitory influences between levels of processing, they do not assume a possibility for an active disruption of processing initiated from outside the processing area.

that reason, they now also become the target of the alpha synchronization, indicating that they also have to be drowned out by the alpha waves, that is, isolated from forming associative networks. It is their ability to be primed by the unconscious conflict words, which shows that the conscious conflict words bear some mark of their etiological origin. In other words, the subliminal UC/supraliminal CS influence is indicative of a cause-and-effect relationship between unconscious conflict and conscious symptom experience. The clinical counterpart of this, then, would be the fact that the participant experiences certain social situations as if they contain an aspect of the unconscious conflict, and therefore both this aspect of the unconscious conflict (equivalent to the UC) and the elements of the social situations (equivalent to the CS) should be isolated by a process, indicated by alpha synchronization, from forming associative connections towards the unconscious conflict proper or its drive derivatives. As a consequence, the subject does not realize that his unconscious conflict is influencing his current conscious experience. For example, if the participant's unconscious conflict revolved around his relationship with his father (as suggested by the example in Table 2), then some aspects of the current social situation (equivalent to the CS), if they happen to be sparked by some unconscious thought derived from the conflict (equivalent to the US), might be at risk of awakening the concerned drive derivatives, and therefore the more there is such a spark, the more the dangerous aspects of the social situation must be isolated from further association. As a result, unbeknownst to the participant, the experience of the current social interaction is influenced by the conflictual interactions with his father. Thus, from a psychodynamic perspective, defense is directed from the activated unconscious conflict toward the social situation. Accordingly, in the experimental set-up, only unconsciously presented unconscious conflict stimuli induce inhibition upon conscious symptom stimuli.

In summary, the results of the three clinical studies indicate that alpha synchronization can also serve to inhibit *unconscious emotional stimuli that elicit conflictual responses*. This considerably extends the scope of alpha inhibition from conscious to unconscious stimuli, from neutral to emotional stimuli, and from generic to individual conflictual stimuli, thus supporting the view that alpha synchronization serves a general inhibitory function. This is consistent with Charles Brenner's hypothesis that psychodynamic defenses are made up of normal cognitive functions put to specific unconscious motivational uses (Arlow and Brenner, 1964; Brenner, 1976, 1982; see also Erdelyi, 2006).

The ODT model

There is one result we have not yet situated in the alpha model. Going back to Clin1, supraliminally presented UC words do not elicit ERP features which allow them to be grouped together, and in Clin2, alpha power upon supraliminally presented UC words does not correlate with alpha power upon CS targets. Why is it that the supraliminal primes are not able to induce alpha pulses, if a signal with exactly the same content, albeit at

much lesser intensity, is thought to elicit this vivid brain reaction? To answer this we have to question the essence of the 'Objective Detection Threshold' methodology, since the two stimuli are identical content-wise, the only difference is that one is subliminal at the ODT while the other is supraliminal.

Content operations are possible at the ODT while localization is not

As mentioned above, the ODT approach objectively qualifies the stimulus as unconscious when there is a complete absence of correlation between the forced-choice responses of the participant and the actual blank-or-stimulus presentations in a separate control detection task. Responding to the question '*is it there (or not)?'* does not require any content information but requires acknowledgement that a mentally present content is a perception rather than an imagination. In a psychoanalytic framework, a distinctive feature of conscious, as opposed to unconscious processing, is precisely the ability to distinguish between a perceived and an imagined stimulation. More precisely, what is needed for this fundamental distinction are the so-called 'indications of reality' (Freud, 1895) – also called 'tags' by Shevrin (1998). Indeed, Freud (1895, p. 325) proposes that for the secondary process to intervene, "it is a question of an indication to distinguish between a perception and a memory (idea)" and formulates the hypothesis that "it is probably the ω neurons which furnish these indications of reality". Previously, we have given extended arguments to defend the idea that the Freudian indication of reality and a modern neuroscience element called 'efference copy' are functionally equivalent – both the Freudian and the neuroscience tradition drawing, independently, from the same source, namely the 19th century physiologist, Hermann von Helmholtz (see Bazan, 2007a, 2007b). Von Helmholtz's (1878, p. 123) original model proposed the idea of a direct sensation of the motor command: "The impulse to move, which we initiate through the innervation of our motor nerves, is immediately perceptible." Accordingly, the efference copies are the messages derived from the motor commands sent out to the peripheral body, which directly feed back to the central nervous system: they inform about the motor command which has been given.[8] In Freud's 'neuronal' model of the mind, the ω neurons are unmistakably motor neurons, since their discharge direction is efferent, that is, "in the direction of motility" (Freud, 1895, p. 311) even though they are "activated along with perception" and "behave like organs of perception" (Freud, 1895, p. 309). Oculomotor neurons make a good example of ω neurons: they are linked with the sense organ of vision and direct their discharges to the muscles of the eye which enable the direction of the gaze. Moreover, Freud (1895, p. 325) indicates: "In the case of every external perception a qualitative excitation occurs in ω … [this] ω excitation leads to ω discharge, and information of this, as of every discharge, reaches Ψ.". Ψ, then, is a system of cortical neurons with memory capacity responsible for mental processes in general (Freud, 1895, p. 300).

[8]While other feedback systems (called 'proprioception' or 'kinesthesia') originate in the muscles themselves and inform of the motor command which was effectively executed.

In other words, in the case of external perception, ω will discharge, (eye) movement will be effectively realized by mobilization of the (oculomotor) muscles, and there will be a central feedback information of this discharge, that is, a feedback of the efferent command to the eye muscles. This is essentially equivalent with the logic of the efference copy. Moreover, since information of the ω discharge is only produced when there is effective, that is, active, perception – for example when there is scanning motor activity in the case of vision – this information, the indication of quality or of reality, furnishes a criterion to distinguish external perceptions from internal images. Freud (1895, p. 325) then adds: "The information of this discharge from ω is thus the indication of quality or of reality for Ψ", that is, it allows "a discrimination between memory and perception" (Shevrin, 1998, p. 252) or a distinction between interior and exterior (see also Bazan, 2008; Bazan and Van de Vijver, 2009a, 2009b). Accordingly, both the psychodynamic (Freud, 1895) and the neuroscience framework (e.g. Obhi *et al*., 2009) propose that these respective instances (indications of reality versus efference copies) are characteristic for conscious processing. In other words, a wide variety of operations, including complex processing, can occur unconsciously because they only require content information, but for the determination of the locus of origin of the stimulus, consciousness through active apperception is needed because it requires efference copy/indication of reality information to situate the origin of the content either outside (perception) or inside (imagination). A 1 ms stimulation is long enough to deliver content information but not long enough to elicit exploitable active apperception. This is the experimental situation wished for in the present research: the possibility of injecting content information without it being recognized as coming from outside. The 1 ms paradigm, then, is not the operationalization of the ecologically infrequent situation of ultrashort external stimulation, but it is an experimental approximation of an *internal* activation, which occurs, for example, when, while the mind is wandering, we bump upon unconscious conflict material.

Two defense dynamics

The only difference between two identical UC stimuli, one being subliminal at the ODT and one being supraliminal, is that only the supraliminal stimulus is grasped by an active apperception movement by the subject, which generates efference copies (Blakemore *et al*., 2003) or indications of reality, while a subliminal stimulus does not. When a stimulus is 'tagged' by the efference copies/indications of reality with the qualification 'actively grasped by the subject', it acquires the status of a perception. The crucial difference now is that only in that latter case is the stimulus submitted to an inhibition process. For example, efference copy-based attenuation has been shown to cancel the feeling of predictable effects of movements (Blakemore *et al*., 2004), including predictable articulation (Heinks-Maldonado *et al*., 2005; Christoffels *et al*., 2007); this is called *sensorimotor attenuation*.[9] Indeed,

[9]That is, the attenuation of the *feeling* of the predictable changes that a *movement* will induce at the level of the muscles, the joints and the skin.

similar to Freud's (1895) idea that a maturating ego increasingly acquires the means to inhibit mental processes by use of the indications of reality, the efference copy model also proposes that with progressive acquisition of movements, there is a growing capacity for an attenuation of the effects of these movements.

Previously, we have proposed, based on several lines of reasoning, that the efference copy-mediated attenuation mechanism is a possible neurophysiological functional principle for repression (Bazan, 2012; Bazan and Snodgrass, 2012). One main argument for this proposed mechanism comes from observations in psychosis, including intensive clinical work of the author with psychotic patients (Bazan, 2012). Indeed, according to certain psychoanalytic theories, repression is thought to be compromised in psychosis: for example, De Waelhens (1978, p. 149) and Laplanche and Pontalis (1973) summarize the evidence in Freud's texts for this idea of the failure of repression in psychosis. In parallel, in cognitive neuroscience, compromised dynamics of the efference copy-mediated attenuation mechanism is thought to explain the hearing of voices (unattenuated feedback of proper subvocal articulation), as well as intrusive feelings, delusions of passivity and loose thought associations in psychosis (e.g. Frith, 1992; Frith *et al.*, 2000; Pynn and DeSouza, 2013). Putting the psychodynamic failure of repression together with the sensorimotor failure of attenuation, we have proposed that this sensorimotor attenuation would at a physiological level also be constitutive of repression. This repression shares its functional principles of efference-copy-mediated attenuation with non-defensive cognitive mechanisms, such as the suppression of activation in order to stop unwanted movements (e.g. Mattia *et al.*, 2012), to constrain visual, movement or speech perception (resp. Hafed and Krauzlis, 2006; Haggard and Whitford, 2004; Niziolek *et al.*, 2013), but also to consciously suppress unwanted memories (Anderson and Levy, 2009). This attenuation mechanism then plays out more typically psychodynamic characteristics especially for highly invested, or highly emotionally charged, (articulation) movement sequences which need to be more permanently attenuated (and which, for that reason induce rebound phenomena; see Bazan, 2012; Bazan and Snodgrass, 2012).

It follows, then, that neither alpha synchronization nor efference copy-induced attenuation is constituted of unique functional principles as compared to conscious or cognitive processes. Rather, we propose that the defensive function is based on their dynamic principles. For example, the alpha hose is used flexibly when needed to consciously inhibit task irrelevant and potentially interfering processes, but when it is supposed to subserve unconscious defense, a *permanent* state of alertness must be assumed. Similarly, efference-copy mediated inhibition is used flexibly for the selection of action alternatives, but when it is supposed to subserve repression, a more *permanent* attenuation of certain representations must be assumed. Therefore, speculatively, we propose that the same functional principles, when used *ad hoc* rather subserve non-psychodynamic mechanisms, and when used with a more permanent character rather subserve psychodynamic mechanisms.

We thus have two possible physiological mechanisms for unconscious defense, efference copy-induced attenuation and targeted alpha synchronization pulses, the efference copy-induced attenuation resembling a permanent wall, and the alpha hose a steerable 'weapon'. The first is initiated proximally to the entrance locus of the perceived stimulus, namely the ego; the second is initiated proximally to the drive derivatives by any percolating activation of the unconscious conflict. Freud (1926, p. 141) says: "A repressed instinctual impulse can be activated (newly cathected) from two directions: from within, through reinforcement from its internal sources of excitation, and from without, through the perception of an object that it desires." We propose to retain this distinction and to reserve the term 'repression' for the ego-initiated efference copy-inhibition mechanism, which through attenuation stops further processing of the external stimulus. The verification for the need of this type of inhibition is mandatory for all actively perceived stimuli. The idea is that the ego has, through the subject's history, acquired autonomy in identifying those perceptions, which need to be placed under stronger and more permanent attenuation, namely those likely to stir up unconscious conflicts and their drive derivatives. In the latter case this inhibition might more resemble a 'protective shield,' of which Freud (1926, p. 93) says that it "exists only in regard to external stimuli, not in regard to internal instinctual demands". For the second defense principle, which works by bouts of alpha pulses, we shall retain Shevrin's term of *unconscious defense*. Another difference between these is that the 'ego-repression' requires precise identification of the stimulus representation because the inhibition is applied as the precise negative of the activation induced by the stimulus (Blakemore *et al.*, 2004[10]) while the 'alpha-hose' doesn't require precise identification since it only aims at the disruption of the integration of the threatening stimulus into existing associative networks.[11] This difference in some ways echoes Freud's (1926, p. 96) observation: "In repression the decisive fact is that the ego is an organization and the id is not."

In other words, the proposed reason that the whole priming range starting from about (roughly estimated) 6 ms or higher will not allow to interfere with unconscious conflicts, is that this is enough time to generate 'ego-repression'; this repression might also match what in mindset priming research has been called *proximal defenses* (see 'Subliminal priming research', e.g. Arndt *et al.*, 2001). Therefore, we think that only subliminal priming at the ODT can bypass this repression.

[10]Note the closeness between the efference copy-attenuation mechanism, which is the exact negative of a movement intention of the subject, and what Freud (1926, pp. 119–20) has called the defensive technique of 'undoing': "the neurotic person will try to make the past itself non-existent. He will try to repress it by motor means ... We thus unexpectedly discover *a new, motor technique of defense*, or (as we may say in this case with less inaccuracy) *of repression*" (italics added).

[11]Metaphorically, the 'ego-repression' is in some ways similar to border control, precisely verifying identity, belongings etc. with possible disarming of the element, and the 'alpha-hose' is in some ways similar to engaging heavy artillery in the direction of any hostile element, which would have intruded undetected.

In conclusion, we propose that working at the stringent conditions of the objective detection threshold of subliminality does make a categorical difference: only in these conditions is one able to by-pass the protective shield against perceived stimuli and thereby tap into the dynamic unconscious of Freudian psychoanalysis which reveals unconscious defense linked to unconscious conflict. Moreover, more than the proposed ego-repression, it is this drive-derivative-linked defense, which, by uncovering the conditions for its release – namely, subliminal stimulation by such politically incorrect stimuli as 'spank me', 'stab me' or 'penetrate' (Shevrin *et al*., 1996) – is uniquely able to reveal the 'scandalous' nature of psychodynamic unconscious mental life by which it radically distinguishes itself from cognitive unconscious systems.[12]

Mental reality and circularity

One of the most trenchant critics of Freud, Adolf Grünbaum (1984), a leading figure in the philosophy of science, has pointed out that empirical support for psychoanalysis must come from methods independent of the clinical method, otherwise circularity is the ever-present danger.[13] The Shevrin lab methodology has proven capable of showing, independent of the clinical method, unconscious inhibition effects, which are best and most parsimoniously understood as unconscious defenses. Using subliminal priming at the objective detection threshold and ERP measures in the same set-up, the Shevrin lab has been able to show brain indications for these unconscious inhibition mechanisms. Moreover, both in Clin1 and in Clin2, the brain ERPs provided independent, non-behavioral, objective indicators that the clinical inferences *a priori* made by psychoanalysts based on psychological meaning of clinical data, has also an existence independent of the clinician's subjective judgment. Most strikingly, we have thus found – and to our knowledge, we have been the first and the only so far – *objective confirmation by brain parameters for psychoanalytic inferences made by psychoanalytic clinicians on the basis of clinical materials*, giving the best indication as yet that these inferences are not simply clinician-dependent subjective interpretations but also imply some form of *independent mental reality*. As these brain parameters have been obtained by theory neutral methods (namely, cognitive investigations incorporating subliminal and electrophysiological methods), independent of the clinical method and with the clinicians not present during the experiment, we propose they effectively respond to Grünbaum's circularity criticism. The present research also enables us to

[12]For example, it is precisely the existence of this type of dynamic unconscious with etiological connections with psychopathological symptoms, which is denied by Rofé (2008, p. 72), based on a lack of experimental evidence: we suggest that the type of findings reviewed in the present paper contribute to an effective rebuttal.

[13]After the publication of Clin1, Professor Grünbaum wrote a letter to Professor Shevrin, acknowledging the quality of the research but challenging the Shevrin team's claim that their evidence demonstrated a cause-and-effect relationship between unconscious conflict and conscious symptom experience. In a subsequent exchange of letters, Shevrin accepted Grünbaum's position and it was this agreement that then led to Clin2. In a follow-up letter, upon the publication of Clin2, Professor Grünbaum would reportedly have answered to his colleague, Professor Shevrin, that he is satisfied.

investigate the nature of this mental reality: if we go back to the results, the one common element which enabled us to pick up independently of the clinicians the stimuli they thought would relate to the unconscious conflict, is alpha synchronization. The only way to relate the alpha synchronization to the clinicians' interpretations is by supposing a third, independent mental reality, constituted by the drive-derivatives proximal to the unconscious conflict, which, when questioned subjectively, results in psychodynamic interpretations, and, when questioned objectively, results in the observation of alpha synchronization. As these drive-derived unconscious conflicts are thought to be characteristic of the deep unconscious, this would then quite nicely correspond to what Freud (1900, p. 613) said, "The unconscious is the psychic itself and its essential reality."

However, there is more. The circularity argument may also be turned on its head: is it not, indeed, the great ambition of our times to unravel the brain architecture down to the last neuron with the hope that we will find in the brain biology all we need to explain its function? In other words, is it not circular to hope to find understanding of how the brain works in the brain itself? What Howard Shevrin and this team have also shown, is that the brain mechanism which is thought to be the physiological counterpart of unconscious defense, namely alpha synchronization, does not *at the level of its brain characteristics differentiate between conscious avoidance and unconscious defense*. There is nothing detectable in the biology of alpha synchronization which distinguishes the two – their biological functional principles are identical – while in the mental apparatus, however, the first one might be thought of as belonging to the ego, and probably the super ego, and the second one closer to the id – which makes for an important difference. This shows that mental apparatus and biological brain are each characterized by their proper principles and distinctions, without there being a one-to-one correspondence between the two objects, at an anatomical, or even at a functional level. It is only through our reliance on the independent reality status of the mental apparatus, using the landmarks it proposes (such as the difference between id and ego), that we could come up with this complex *psychological* experiment based on *psychological meaning*, eventually revealing this new function of the alpha waves. It is because the mental apparatus has an epistemologically autonomous status, with an organization proper not modeled after the organization of the brain, that it is in a position to offer an added value for the interpretation of brain mechanisms. Our proposition, then, is that, more than simply allowing us to escape Grünbaum's circularity criticism pertaining to psychoanalysis, this methodological approach offers a way to escape neurobiological circularity, that is, it offers meaningful interpretations of brain findings, with a perspective *on* its functioning rather than a perspective coming *from* within its functioning.

In conclusion, we have summarized research by Howard Shevrin and his team, which shows the existence of unconscious defense initiated internally, that is, independent of external perception and which, moreover, proposes a brain mechanism for its physiological instantiation, namely alpha synchronization. The research results only make sense if we suppose the existence

of a complex, dynamic unconscious, which has inherited childhood conflicts (of a 'scandalous' nature), and with privileged connections to neurotic symptom characteristics. Moreover, the research also brings independent objective evidence for the validity of analysts' interpretations as indeed pertaining to the unconscious conflicts of the participants. Finally and speculatively, interpretation of the results has led us to propose two distinct defensive physiological mechanisms, one, unconscious defense by alpha synchronization in connection with the drive derivatives, and another, repression by efference copy/indications of reality-attenuation, initiated by the ego.

Translations of summary

La synchronisation alpha comme modèle cérébral des défenses inconscientes: une synthèse des travaux de Howard Shevrin et de son équipe. Howard Shevrin et son équipe ont développé une méthodologie d'amorçage subliminal à des conditions de présentation strictes, qui simule expérimentalement une situation de déclenchement interne, mental de défenses inconscientes. A l'aide d'une série de quatre études, ils peuvent ainsi étayer expérimentalement ce type de défense inconsciente. A l'aide de « Potentiels Evoqués », trois études cliniques montrent comment la synchronisation d'une onde spécifique du cerveau, l'onde alpha, connue pour sa fonction inhibitrice, est également induite par des stimuli conflictuels, spécifiques aux sujets, quand ils sont présentés de façon subliminale. Par conséquent, la synchronisation des ondes alpha peut aussi constituer le mécanisme cérébral de la défense inconsciente. Les résultats ne font sens que si nous supposons l'existence d'un inconscient dynamique, qui a hérité des conflits de l'enfance, et qui a des connexions privilégiées avec les caractéristiques des symptômes névrotiques. Qui plus est, en montrant que les phrases indiquant le conflit inconscient, déduites par les cliniciens à partir d'entretiens cliniques, ont un comportement cérébral similaire, Shevrin et son équipe apportent une preuve que ces déductions ne sont pas de simples interprétations subjectives mais qu'elles impliquent aussi une forme de réalité mentale indépendante. Finalement, l'interprétation des résultats nous amène à proposer deux mécanismes physiologiques distincts de défense: un, la défense inconsciente, par synchronisation alpha en rapport avec les dérivés des pulsions, et l'autre, le refoulement, basé sur les indications de réalité en rapport avec le moi.

Die Alpha-Synchronisierung als Gehirnmodell der unbewussten Abwehr: eine Darstellung der Arbeit Howard Shevrins und seines Teams. Howard Shevrin und sein Team haben eine stringente subliminale Priming-Methode entwickelt, die experimentell einer Situation nahe kommt, in der eine unbewusste Abwehr mental getriggert wird. In insgesamt vier aufeinanderfolgenden Studien konnten sie diese Art unbewusster Abwehr empirisch nachweisen. Ausgehend von ereignis-korrelierten Potentialen (Event Related Potentials) ergaben drei klinische Studien, dass die Synchronisierung einer spezifischen Hirnwelle, der Alpha-Welle, deren inhibitorische Funktion bekannt ist, auch durch subliminal präsentierte, konfliktträchtige und probanden-spezifische Stimuli herbeigeführt werden kann. Die Ergebnisse ergeben nur dann Sinn, wenn wir die Existenz eines dynamischen Unbewussten voraussetzen, das Kindheitskonflikte geerbt hat und besondere Verbindungen zu den charakteristischen Eigenschaften neurotischer Symptome aufweist. Indem Shevrin und sein Team zeigen, dass die von Klinikern aus klinischen Interviews rückgeschlossenen Formulierungen, die auf einen unbewussten Konflikt verweisen, ähnliche Aktivitätsmuster im Gehirn besitzen, belegen sie, dass diese Rückschlüsse nicht lediglich subjektive Interpretationen des jeweiligen Klinikers darstellen, sondern dass sie tatsächlich eine unabhängige mentale Realität betreffen. Und schließlich hat uns die Interpretation der Ergebnisse veranlasst, zwei verschiedene physiologische Abwehrmechanismen zu postulieren, nämlich eine unbewusste Abwehr, die durch die Alpha-Synchronisierung in Verbindung mit den Triebabkömmlingen erfolgt, und eine weitere, die Verdrängung, die mit der Realitätswahrnehmung und der Ich-Aktivität zusammenhängt.

La sincronizzazione dell'onda alfa come modello cerebrale per le difese inconscie: uno sguardo d'insieme al lavoro di Howard Shevrin e della sua equipe. Howard Shevrin e la sua equipe hanno sviluppato un metodo di priming subliminale, da attuarsi in condizioni di stretto controllo, per simulare sperimentalmente una situazione di attivamento interno, mentale, di difese inconsce. Attraverso una serie di quattro studi, il gruppo di lavoro è stato in grado di portare delle prove rispetto a questo tipo di difesa inconscia. Valendosi dei dati provenienti dalla misurazione di potenziali evento-correlati, tre studi clinici mostrano come la sincronizzazione di una specifica onda cerebrale – l'onda alfa, nota per la sua

funzione inibitoria – viene anche indotta da stimoli conflittuali specifici per ogni soggetto e a quest'ultimo presentati in forma subliminale. Si potrebbe quindi guardare alla sincronizzazione dell'onda alfa come al meccanismo cerebrale che presiede alle difese inconsce. I risultati di questi esperimenti hanno senso unicamente quando venga data per acquisita l'esistenza di un inconscio dinamico che ha ereditato i conflitti dell'infanzia e che ha inoltre delle connessioni privilegiate con le caratteristiche dei sintomi nevrotici. Inoltre, mostrando che le frasi indicanti i conflitti inconsci (dedotti dai clinici a partire da interviste con i soggetti degli esperimenti) presentano un comportamento cerebrale simile, Shevrin e la sua squadra hanno potuto altresì provare che le loro inferenze a proposito di tali frasi non sono delle semplici interpretazioni soggettive, ma implicano al contrario una forma indipendente di realtà mentale. In ultimo, l'interpretazione dei risultati ha portato a ipotizzare l'esistenza di due meccanismi fisiologici diversi, entrambi con funzione difensiva: il primo, quello della difesa inconscia, espresso da una sincronizzazione dell'onda alfa legata ai derivati delle pulsioni, e il secondo, la rimozione, basato sulle indicazioni della realtà in relazione all'Io.

La sincronización alfa como modelo cerebral de la defensa inconsciente: Panorama del trabajo de Howard Shevrin y su equipo. Howard Shevrin y su equipo han desarrollado una metodología rigurosa del priming subliminal que experimentalmente se aproxima a una situación de disparador mental interno de una defensa inconsciente. Mediante una serie de cuatro estudios traen evidencias de este tipo de defensa inconsciente. Tres estudios clínicos muestran, por medio de Potenciales Relacionados con Acontecimientos (ERP, por sus siglas en inglés), cómo la sincronización de una onda cerebral específica, la onda alfa, conocida por su función inhibidora, también es inducida al presentarse subliminalmente estímulos temáticamente conflictivos. De allí que la sincronización alfa pueda servir como el mecanismo cerebral de la defensa inconsciente. Los resultados solo cobran sentido si suponemos la existencia de un inconsciente dinámico, que ha heredado los conflictos de la niñez y con conexiones privilegiadas con las características de los síntomas neuróticos. Además, al mostrar que las frases conflictivas inconscientes, inferidas por los clínicos a partir de entrevistas clínicas, tienen un comportamiento cerebral similar, Shevrin y su equipo proporcionan evidencias de que estas inferencias no son simplemente interpretaciones subjetivas dependientes del clínico, sino que también implican alguna forma de realidad mental independiente. Por último, la interpretación de los resultados conduce a proponer dos mecanismos de defensa fisiológicamente distintos: uno, la defensa inconsciente, mediante la sincronización alfa en conexión con los derivados pulsionales; y otro, la represión, basado en las indicaciones de realidad en conexión con el yo.

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Appendix

Subliminal priming research

(1) Different laboratories over the world use different presentation times for subliminality, varying between 1 and 21 milliseconds (ms), sometimes even up to 50 ms. For the smallest presentation times (1 to 7 ms), an 'old-fashioned' tachistoscope must be used, because the refresh rates of even the fastest computer screens are not high enough. A tachistoscope is a mechanical T-shaped wooden device allowing fast presentation of visual elements by mastering the switch on/off-times of the

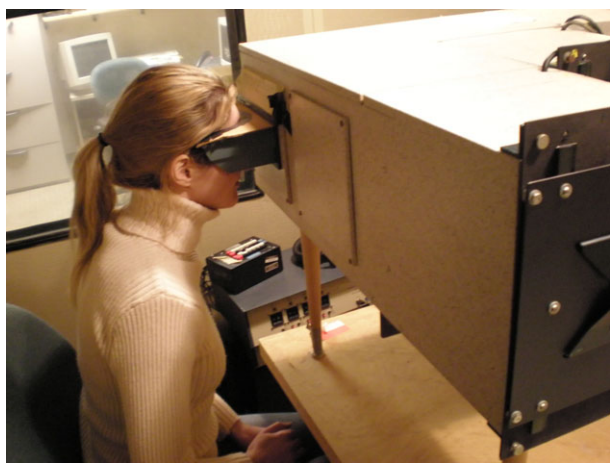

Figure 1. Participant attending to a stimulus presented by the Shevrin lab tachistoscope, i.e. a mechanical T-shaped wooden device allowing fast presentation of visual elements by mastering the switch on/off-times of the lamps flanking the presentation fields.

lamps flanking the presentation fields (see Figure 1 for the Shevrin lab tachistoscope). In the objective detection methodology, the participant is forced to choose on each presentation of a detection series, if he thinks that something was presented or not. In this control experiment, the participant is told that half of the presentations will contain the stimulus (though, subliminally presented) and half of the presentations will be blank and that he has to distribute his answers more or less evenly between 'something' or 'nothing'. In other words, even if he doesn't see something, he is not allowed to answer 'nothing' on each trial. All experiments in the Shevrin lab are done at zero detection.

The initial social phobia study: Event-related potential indicators for unconscious conflict

(2) The protocol for the word selection is an application of the Delphi method. The Delphi method was devised in order to obtain the most reliable opinion consensus of a group of experts by subjecting them to a series of questionnaires in depth, interspersed with controlled opinion feedback (Dalkey and Helmer, 1963). Dalkey identified its two basic assumptions: (a) in situations of uncertainty (incomplete information or inadequate theories) expert judgment can be used as a surrogate for direct knowledge, (b) in a wide variety of situations of uncertainty, a group judgment (amalgamating the judgments of a group of experts) is preferable to the judgment of a typical member of the group. The exercise thus involves a group; its goal is information, that is, the exercise is an inquiry; the information being sought is uncertain in the minds of the group; some preformulated systematic procedure is followed in obtaining the output (Linstone and Turoff, 1975, p. 236). While wishing to use the strengths inherent in expert clinical judgments, Shevrin and colleagues also used this Delphi method, (1) to select words on the basis of a group expert judgment as opposed to depending on the judgments of a single expert, and (2) to use a 'preformulated systematic procedure' in obtaining the corporate judgments, one that could be readily understood and replicated by others. In addition, eight highly unpleasant words, unrelated to the participant's story and drawn from the negative end point of the evaluative dimension of the Osgood Semantic Differential (Osgood Negative or ON words; Osgood *et al.*, 1975), were added to the composite word list to control for unpleasant affect.

(3) Shevrin and team used a so-called 'time-frequency' analysis of the ERP data whereby frequency is the number of electric wave cycles of the ERP signal per second. While standard ERP methods depict brain responses in two dimensions (time and amplitude), time-frequency methods (Williams and Joeng, 1989) add the dimension of frequency. The crucial difference here is that this method allows not only picking up instantaneous amplitude changes such as in classical ERP methods, but also instantaneous frequency changes. The amplitude allows calculating the 'power' or 'energy' as amplitude^2 and this power estimates the magnitude of oscillatory amplitude within a defined time window; it is also

a measure of wave synchronization. Time-frequency methods thus represent event-related brain responses as the frequency and power present at each time bin on each trial, rather than only the amplitude at each time bin, as in usual ERP methods (see for details Shevrin *et al*., 1996: 139, Appendix B).

(4) The statistics for this interaction were: $r(20) = 2.82$; $p < .05$. The alternate explanation, namely that UC words may simply be more unpleasant for the subject than the CS words and that this would explain the results, does not hold as subject ratings on the Osgood evaluative dimension showed no difference in unpleasantness between the CS and the UC words.

(5) An information flow measure was used to test whether the unconscious conflict and conscious symptom words formed unique categories by scrambling the words across categories to form new pseudo-categories. Significantly more stimulus related information flowed between electrodes for the true categories than for the pseudo-categories. This measure is an adaptation of Shannon-type information measure to assess stimulus-related information flow between pairs of electrodes (Kushwaha *et al*., 1992).

(6) The correlation between the percentage correct classification *difference* between subliminal and supraliminal for the UC category (high score in favor of subliminal condition) with the HOQ score was .77 ($p < .05$). The comparable correlations for the conscious symptom words and the control words were both non-significant.

The Spider Phobia study: Alpha synchronization as an unconscious defense mechanism against threat

(7) Increased or decreased alpha power is in comparison to control alpha power (elicited by the control stimulus, a rectangle). Control results for snake phobics were all non-significant.

The second social phobia study: Brain evidence for conflict-induced unconscious inhibition

(8) A set of 7 Osgood Negative Valence (ON) words, selected uniquely for each participant, served as the control (Osgood *et al*., 1975). The statistics for the subliminal UC prime-CS target correlation were: partial $r = .68$; $p < .05$ and were even stronger in the back of the brain (i.e., parietally): partial $r = .81$; $p < .01$. By contrast, subliminal UC prime alpha had no effect on ON target alpha. Supraliminal CS primes came close to positively predicting CS target alpha (partial $r = .56$; $p = .11$) and did predict ON target alpha (partial $r = .70$, $p < .05$). The supraliminal CS prime findings were stronger frontally (CS target: partial $r = .66$, $p = .05$; ON target: partial $r = .81$, $p < .01$), but non-significant in the back of the brain (i.e., parietally). All results are from Shevrin *et al*. (2013). How can we understand the alpha power effect found for the supraliminal CS primes on the CS and ON target alpha power? The CS words describe the aspects of the social situation that are most

anxiety provoking to the participant, as well as the physiological signs of anxiety the participant experiences in the uncomfortable social situation. It seems reasonable to suppose that these words are overtly disturbing because they bring back the conscious social phobic experience itself. Therefore, the supraliminal alpha-inhibition is a consciously induced aversive mindset leading to avoidance of subsequent negativity, resembling the conscious inhibition results on alpha found previously (Klimesch *et al*., 2007). The results suggest that the defensive effect of the subliminal unconscious conflict primes is more closely associated with parietal alpha, while the alpha power effect of the supraliminal conscious symptom primes is more closely associated with frontal alpha. The spatial repartition is coherent with literature associating conscious control with frontal activity (e.g. Walsh *et al*., 2010; Pani *et al*., 2014).

