Is Splitting Related to Resistance to Proactive Interference? A Process-Oriented Study of Kernberg’s Conceptualization of Splitting

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Abstract
Introduction: Splitting, as a defense mechanism in Kernberg’s theory, plays a significant role in the development and maintenance of polarized and oscillating representations of self/other characteristics of borderline personality disorder (BPD). Although the notion of splitting can be considered from a structural and a functional point of view, almost all empirical studies to date have focused on the former elements to the detriment of related cognitive processes.

Methods: To further investigate the cognitive processes related to splitting, 60 participants were administered the Splitting Index and indexes of resistance to proactive interference (PI) using the interpersonal recent negative task with words that reflect negative or positive interactions compared to neutral words.

Results: The use of splitting was uniquely and significantly predicted by a higher capacity to resist PI and a lower capacity to consistently maintain this resistance when presented with negative words, above and beyond BPD traits, primitive defenses, and the presentation of neutral words. Results showed no evidence of a relationship between splitting and resistance to PI with positive words.

Conclusion: Results appear compatible with Kernberg’s conceptualization of splitting as an active defense process that relates to an unstable capacity to inhibit negative representations of the object from entering working memory.

Introduction

Splitting, as a defense mechanism, occupies a central place in the psychoanalytical literature as a result of its usefulness in explaining several psychopathologies, ranging from hysteria [1], perversion [2], personality disorders [3, 4], to psychosis [5]. Although it has been giving several meanings, it often refers to a defense mechanism whose function is to split off whole personalities, awareness of disturbing realities, good and bad representations of the object, or the mind itself [6]. Contrary to repression, which functions to keep representations out of consciousness in a constant manner, splitting is particular in that it allows each side of conflicting representations al-
ternating access to consciousness [7]. Despite its abstract nature, the concept of splitting has made it possible to account for contradictions observed in borderline personality disorder (BPD), such as feelings and perceptions toward self and others as being all good or all bad, as well as various associated manifestations: sudden mood swings, difficulties in maintaining stable interpersonal relationships, fragile self-esteem, diffuse identity, and problems with anger and impulsive behavior, to name just a few [8].

In Kernberg’s theory, splitting refers to the segregation of structural elements of personality into positive and negative affective states and object relations (a representation of the self and a representation of another person linked by a positive or negative affect), as well as to the defensive process responsible for this segregation [9]. This theory has not only inspired the development of therapeutic models but also several currents of research with direct, or indirect, interest in splitting. Although Kernberg’s notion of splitting can be seen from both structural and functional points of view, it is interesting to note that almost all empirical studies to date have only focused on the structural elements. One of the possible reasons for this scarcity of research on the processes associated with splitting may relate to the difficulty involved in developing instruments that can measure how they work. The purpose of the present study was to use a task from the cognitive sciences, the recent negative task (RNT), and test hypotheses about certain cognitive processes thought to be involved in splitting. More specifically, the first objective was to verify the unique contribution of resistance to proactive interference (RPI) with relational words of negative valence, as measured with the RNT, in the prediction of splitting, as measured with the Splitting Index (SI) questionnaire, by controlling for the effect of neutral words, BPD traits, and primitive defenses. The second objective was to verify the contribution of the RPI with relational words of positive valence in the prediction of splitting. To verify if the association between RPI and splitting is specific to this defense mechanism, as a third objective, we repeated the regression analyses to verify the unique contribution of the RPI in the prediction of primitive defense mechanisms by controlling for the effect of splitting.

Kernberg’s Conceptualization of Splitting

Since Freud’s first conception [10], the notion of splitting has been criticized over the years for lacking clarity in its explanation of what is being split and for the confusion surrounding the object and the subject of the splitting [11]. Specifically, if the ego is the object of the splitting, then the question becomes who is its subject, or who is responsible for it? Although psychoanalytic theory is quite comfortable with this type of paradoxical description of the human mind, one can still make progress on addressing these questions by studying the phenomenon of splitting more formally. An interesting paradox about splitting can be found in Kernberg’s theory and merits consideration. Indeed, this theory presents splitting as both a structure and a function [9]. The child is proposed to develop the structural elements of his or her personality through interactions with caretakers [12]. Among the basic elements of the psychological structure, dyads composed of a representation of the self and a representation of the other are linked by a positive or negative affect. During moments of intense affect activation (e.g., moments of frustration or gratification for the child), these representations come together around a negative or positive affect to form specific affective memory structures. Consequently, the child, whose cognitive apparatus is still immature, builds representations charged with positive affects that are distinct and separate from those charged with negative affects. As the child’s cognitive abilities develop and they experience moments where affects are less intense, the child becomes better able to perceive their caretakers realistically, representing them with both positive and negative affective qualities. This process of maturation facilitates the development of new psychic structures comprised of representations of self and others that are more affectively integrated (e.g., ego identity, super-ego). These new personality structures are organized hierarchically to ensure a better control on the emotional and interpersonal functioning. From a structural point of view, splitting thus refers to the structural set of segregated affective states and object representations, as seen in BPD patients [9].

Regarding splitting as a function or process, Kernberg’s theory postulates [12] that following certain developmental conditions (e.g., aggressive constitution or traumatic experiences), the child protects themself against strong ambivalent feelings toward their caretaker by keeping negative and positive representations separate. The following quote gives an explicit description of splitting as a process: “splitting of positive and negative sectors of experience is a motivated mental operation, often described as a defensive operation, representing an effort to maintain an ideal domain of experience characterized by the gratifying and pleasurable relation between self and others, while escaping from the frightening experiences of negative affect states” ([12], p. 123). What are being split is not only the affective states of the ego but also the self and ob-
Splitting and Resistance to Proactive Interference

Studies of Splitting from a Structural Point of View

Most studies have investigated splitting from the perspective of personality structure. For example, a question that has interested clinical studies has been whether dichotomous thinking (or splitting) in BPD patients is unidimensional versus multidimensional in nature [13]. Beck’s theory [14] proposes the existence of contradictory dysfunctional cognitive schemas (e.g., beliefs about being incompetent and needing protection from others vs. beliefs about others as being malevolent and rejecting), whose activation (under different circumstances) would form the basis for sudden changes in the patient’s perceptions of self and others. In the cognitive theory, these perceptions would be extreme yet multidimensional (e.g., they could be a mixture of both positive and negative beliefs simultaneously held toward the same person). According to Kernberg’s model [7], split representations of self and other, being organized around positive and negative affects, can only give rise to extreme and unidimensional perceptions of the self or another person depending on the circumstances. Based on BPD participants, clinical and nonclinical controls evaluations of characters in film clips or of real persons in social interactions, results across two studies provided overall support for the hypothesis of a thinking style that is multidimensional in nature [15, 16]. However, it is unclear whether these results, obtained with explicit visual analog scales as a measure of splitting, are generalizable to real-life situations [13].

The notion of segregation between positive and negative representations of self and others in a person’s memory (or schemas) has been adopted by the field of social psychology, although without connecting the theoretical framework with splitting [17–20]. In one of the first studies, Graham and Clark [17] were interested in testing the hypothesis that individuals with low self-esteem store positive and negative information about their partner separately in memory. According to the authors, during times of low interpersonal threat, low self-esteem individuals will focus their attention exclusively on the positive attributes of their partners as a means to approach them and perceive them as the perfect partner, as one who will neither reject them nor reflect on them in a negative manner. Conversely, because of having perceived signs of impending rejection, these individuals will switch their focus onto the negative attributes of their partners in preparation of future abandonment. This cognitive style then leads to the build-up of two functionally separate stores of partner information: one that is positive and one that is negative. Alternatively, high self-esteem individuals feel accepted by others and approach partners without fear. Consequently, they are not worried about the implications of others for themselves. This capacity allows them to focus on both the positive and the negative attributes of their partners and store naturally occurring ties between the two. Graham and Clark [17] used a task that compared the speed with which participants judged a series of positive and negative traits as a characteristic of a significant other. Results showed that compared to high self-esteem individuals, low self-esteem individuals took longer to respond when positive and negative traits were presented in an alternating order instead of a nonalternating order, clustering the traits by valence. In support of the hypothesis that low self-esteem individuals have segregated memory stores of positive and negative information about their partners, results were interpreted to reflect the extra time needed to access information in memory; when that access is required to switch from a positive to a negative memory store (or vice versa) each time, a new trait is presented.

Overall, from a structural point of view, empirical studies of splitting are important for describing how representations are organized, but they tell us very little about the processes responsible for this segregation. What process is responsible for the segregation of this information? In Graham and colleagues’ [17] studies, it is postulated that attentional mechanisms would lead low self-esteem individuals to focus their attention on either positive or negative information depending on the circumstances. However, without measuring attentional processes, this question remains unanswered.

Similar conceptual efforts have been devoted to describing the structural elements of splitting in neuroanatomical terms. The prevalent conceptualization in this line of research proposes that there are distinct locations in the brain for positive and negative representations for BPD patients. For example, in Muller’s model [21], it is noted that the pathological use of splitting during the
child’s separation-individuation period (18–36 months) to resolve ambivalent conflicntal feelings toward caretakers also corresponds to a period when interhemispheric connections have not fully matured. According to the author, this recourse to splitting would lead to a deficient cerebral organization in terms of the integration of positive and negative engrams of parental figures. In accordance with the knowledge of the time regarding cerebral organization of emotions, the author postulates that splitting would impose the development of engrams of “the bad mother” in the right hemisphere (which was seen as more involved with negative emotion) and engrams of “the good mother” in the left hemisphere (which was seen as more involved with positive emotion). This interhemispheric organization would persist once acquired and would influence the perceptions of self and other in the adult. More recently, Kernberg [22] has also proposed the idea of distinct brain structures to describe the neurobiological correlates of split object relations in BPD patients. According to this proposal, subcortical structures that include the nucleus accumbens, the tectum, the amygdala, and the hippocampus would be involved in the segregation of positive and negative representations of self and others, whereas cortical structures, notably the prefrontal cortex and the anterior cingulum, would be involved in the integration of these representations. Again, as with the empirical studies, these theoretical conceptualizations tell us little about the processes involved in splitting.

Studies of Splitting from a Process Point of View

The idea of studying the processes related to splitting is not new. Indeed, beginning in the late 1970s, Horowitz and his colleagues [9, 23, 24] developed the configurational analysis approach to verbatim transcription of therapeutic interactions with the aim of reporting the cognitive processes that accompany defensive processes in the moment-to-moment discourse of psychotherapy. These cognitive processes were defined in three sectors of cognitive operations: the control of content (i.e., focus of attention), control of the form (i.e., modes of representation), and control of the repertoires of schematization (i.e., self-schemas). Based on this systematic approach to the processes that take place during the interview, the researchers were able to translate the phenomenon of splitting into cognitive processes. For example, according to the authors, the transition from a “defective self with an ideal disinterested other” constellation to an “ideal disinterested self with a defective other” constellation makes it possible to describe what is happening on a defensive level. On the other hand, the use of a cognitive process called “role-relationship models shifting” makes it possible to understand how this transition was achieved on the cognitive level. The advantage of such an approach is to account for the cognitive processes related to splitting. However, what is measured in such an approach remains the phenomena observed on the surface during the patient’s verbalizations while the underlying processes are inferred.

Today, cognitive sciences offer us behavioral tasks that allow us to measure precisely how information is processed in working memory. It is possible to wonder whether such tasks could be used to better describe the cognitive processes related to splitting. This idea seems even more promising since it has been shown that it is possible to study identity diffusion (which is related to splitting from a structural point of view) and splitting separately [25].

Inhibition Functions and Splitting

Among the cognitive functions, those related to the regulation of contents in working memory appear relevant to the study of splitting. Indeed, it is possible to conceive of splitting as regulating the contents of subjective experience in its own way by allowing certain representations to be present in consciousness while keeping others out. This conception of splitting puts the emphasis on a regulation of internal contents. There is an inhibition process whose function is to resist interference whose source is precisely internal. This cognitive inhibition process, called RPI, refers to the suppression of irrelevant information from working memory [26, 27]. This inhibition process is distinguished from two other inhibition processes whose source of interference is external: resistance to distractor interference and prepotent response inhibition. Evidence of these three processes of inhibition has been empirically shown by factorial studies on a range of inhibition tasks [27]. In general, studies of inhibition processes have reported that inhibition performance among BPD individuals is significantly reduced, especially when presented with negative emotional stimuli or self-referential material that contains themes specific to BPD, such as abandonment [28]. To explain the particular effect of emotional stimuli on the three inhibition processes of BPD individuals, Gagnon and colleagues [28] proposed a model adapted from certain propositions of Kernberg’s theory. Here, the BPD self-concept belongs to long-term memory and is composed of split representations of self and other that will likely produce intense emotional responses and consequently disrupt the process of resistance to distractor interference and prepotent...
response inhibition. For its part, the process of splitting, which separates negative self- and other-representations from positive self- and other-representation, belongs to working memory as a cognitive control process and would be more specifically linked to the RPI. The present study proposes to verify this hypothesis, for which there is indirect evidence from two sources.

First, studies of the neuropsychological profiles of BPD individuals have reported evidence of RPI difficulties. For example, using the directed forgetting task, Korfine and Hooley’s [29] study showed that, unlike control participants, BPD participants continued to encode words involving a BPD theme even though they were instructed to forget them. According to the authors, the results suggest that these participants demonstrate a weakness in cognitive inhibition that results in working memory being cluttered with words that are no longer relevant to the task. A recent study among undergraduate students also found links between BPD traits and a weakness in RPI in the presence of angry faces [30]. Another source of indirect evidence for the association between splitting and RPI comes from the Hoermann and colleagues’ study [31] that divided BPD patients into three subgroups according to their effortful control abilities. The results of this study showed that the subgroup of patients with low effortful control abilities were also those who presented characteristics of borderline personality organization, notably primitive defense mechanisms and diffuse identity.

This indirect evidence raises three questions. The first concerns the specificity of the relationship between splitting and RPI, namely whether it is possible to find associations between these constructs after controlling for the effect of BPD traits and primitive defense mechanisms. The second question concerns the role of RPI in splitting. Indeed, studies of the neuropsychological profile of BPD patients suggest that splitting would be associated with a weakness in the ability to perform RPI. For example, splitting would reflect a disruption in the ability to inhibit negative representations, an inability to prevent these representations from invading working memory. On the theoretical level, this effect would reflect what Kernberg calls the contamination of negative object relations with positive self-representations and positive object relations in the patient’s subjective experience. Given the weakness of the RPI, the patient would no longer be able to inhibit these negative representations from entering in working memory to make room for positive representations. However, one of the intriguing formulations in Kernberg’s theory concerns the idea that splitting serves to keep positive and negative representations actively separate, precisely to avoid this contamination effect. This idea suggests, on the contrary, a certain capacity to exercise inhibitory control over the representations in working memory. Relatedly, this proposal means that a significant other in a social interaction with the patient can activate both positive and negative representations at the same time but that cognitive inhibition processes would be able to inhibit the entry of negative representations into working memory while allowing the entry of positive representations if social circumstances are favorable. Support for the hypothesis of activated ambivalent positive and negative representations is found in an experimental study showing that the name of a significant person had facilitating priming effects for both positive and negative judgments [32]. To address these questions about the role of RPI in its association with splitting, the present study proposes to use the RNT to measure the RPI.

**RNT and Splitting**

The advantage of RNT for studying splitting is that it sets in motion automatic nonconscious inhibitory processes to resolve a conflict between two types of representations that are representations with familiarity cues and representations with contextual cues [33]. Specifically, the task consists of presenting a set of three words followed by a retention period and ending with the presentation of a target. Participants are asked to respond as quickly and correctly as possible if the target was one of the three words. In this task, we are particularly interested in so-called negative responses, e.g., trials where the target was not part of the set and requires a negative response from the participant. The conflict occurs when the target is not part of the set of the current trial but was part of the set of the previous trial. This trial is called a recent negative trial because the target has a conflicting status by being negative, e.g., not belonging to the context of the current set but still being familiar because it was recently presented.

Studies showed that recent negative trials lead to an increase in reaction time (RT) and percentage of error compared to nonrecent negative trials [34] and would activate the left inferior frontal cortex [35]. This is explained by the conflict that recent negative trials entail, which requires resolution by cognitively inhibiting the familiar representation to allow contextual representation to enter working memory [33]. Subtracting the RT or error rate of nonrecent negative trials from that of recent negative trials yields a proactive interference (PI) index. The PI index reflects the extra time necessary to resolve the conflict.
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positive and negative valence alongside their theoretical
expected links between the RPI, splitting, and words with

charge words.

In summary, the aim of this study was to explore the
associations related to the use of splitting, as measured by
the questionnaire, and an index of the RPI (the PI index),
using the RNT. More specifically, the first objective was
to verify: (a) whether there is an association between the
use of splitting and a PI index associated with words that
are negative in valence; (b) whether this association is re-
lected by a positive (first hypothesis) or negative (second
hypothesis) correlation, suggesting that splitting is relat-
ed to a deficit or a capacity of the RPI, respectively; and
(c) whether a measure of CoV of the PI index contributes
to a unique way in the prediction of splitting and beyond
the standard PI index (third hypothesis). The second ob-
jective was to examine these same associations (between
splitting and the PI index) with words that are positive in
valence. To control for any confounding effects of bor-

Table 1. Expected correlations (in parentheses) between the splitting score and PI index with words of negative or positive valence alongside their theoretical propositions relative to before versus after a frustration versus a gratification in real-world interactions

|                | Frustration |                       | Gratification |                       |
|----------------|-------------|-----------------------|--------------|-----------------------|
| **Before**     |             |                       |              |                       |
|                | Capacity to inhibit negative object representations from entering working memory when positive object representations are activated in working memory (negative correlation between splitting and PI indexes with negative words) | Capacity to inhibit positive object representations from entering working memory when negative object representations are activated in working memory (negative association between splitting and PI indexes with positive words) |
| **After**      | Difficulty inhibiting negative object representations from entering working memory leading to a flooding of activated negative object representations in working memory (positive association between splitting and PI indexes with negative words) | Difficulty inhibiting positive object representations from entering working memory leading to a flooding of activated positive object representations in working memory (positive association between splitting and PI indexes with positive words) |

During the recent negative trials and an estimation of the
RPI. The higher the PI index, the lower the RPI. Trans-
posed to the splitting theory, this task allows us to test
whether splitting is associated with a deficit or capacity of
the RPI. Indeed, a positive correlation between a measure
of splitting and the PI index suggests that splitting score
increases in parallel with a weakness in RPI. Conversely,
a negative correlation between the splitting score and PI
index suggests that as splitting increases, RPI increases as
well.

In addition to potentially seeing links between split-
ting and a cognitive inhibition process, the RNT can also
help to verify whether associations vary according to the
valence of the words used. According to the theory, split-
ting protects positive object representations from being
contaminated by negative object representations. This
proposal suggests that the associations between splitting
and the RPI may differ depending on whether the words
in the RNT are of positive or negative valence. Moreover,
it needs to be underlined that according to clinical obser-
vations, the patient who uses splitting can remember and
be aware of the behavior and attitude that were enacted
during the manifestation of the contradictory side of his
current domain of experience but do not feel emotionally
connected with it [7]. This is an additional reason to use
a RNT with emotional words reflecting negative and pos-
tive interactions with others. Table 1 summarizes the ex-
pected links between the RPI, splitting, and words with
positive and negative valence alongside their theoretical
propositions.

Finally, in addition to the two alternative hypotheses
about splitting as associated with a RPI deficit (positive
correlation) or capacity (negative correlation), there is a
third possibility to conceptualize the association between
the two constructs that of a weakness in consistently per-
forming an inhibitory function on representations. This
fluctuation in the RPI process could, e.g., reflect the fact
that representations of self and other in relation to split-
ting are rapidly changing according to circumstances. To
test this third hypothesis, it is possible to use a PI index
that measures the fluctuation of performance during the
RNT task. This index is called coefficient of variation
(CoV). Associations have been made between a measure
of CoV in performance and several cognitive functions,
such as working memory capacity, fluid intelligence, and
long-term memory [36]. The CoV index is obtained for
each participant by dividing the standard deviation by the
average score (SD/M). This index is thought to reflect the
degree to which attentional control processes that are al-
located to maintain optimal levels of performance are op-
erating efficiently and consistently. We therefore wish to
apply the CoV to a PI index as a measure of the difficulty
to consistently resist to PI when encountering affectively
charged words.
nderline personality traits and primitive defenses and to ensure for the effect of the valence of words, we use a measure of borderline personality traits, a measure of primitive defense mechanisms, and a PI index with neutral words as control variables. According to the theory [12], splitting is functionally associated with other primitive defense mechanisms. Consequently, the third objective was to verify whether the previous discussed associations are specific to splitting rather than to primitive defense mechanisms in general. To meet this objective, the same PI indexes and control variables will be further applied using a general measure of primitive defense mechanisms as the dependent variable and in this case, with splitting serving as the control variable.

Methods

Participants

The present study was conducted with a sample mainly recruited among university students from various disciplines. However, to obtain more variability on splitting scores, participants were also recruited from the general population through advertisements placed on websites and throughout the community and from patients consulting in a personality disorders clinic. All respondents were given an online screening questionnaire assessing the study inclusion and exclusion criteria. Participants were excluded from the study if they (i) were not between 18 and 35 years of age, (ii) did not indicate French as mother tongue, (iii) reported having suffered from any serious head injury, (iv) were diagnosed with attention-deficit/hyperactivity disorder, or (v) had a history of psychosis. The sample size was determined to obtain 80% of statistical power, with an expected medium effect size.

Measures

Splitting Index [37]

The French version of the SI [25] is a 24-item self-report instrument designed to assess the defense mechanism of splitting, as described in the writings of Kernberg (e.g., [7]) on self and object representations. This self-report questionnaire was initially developed and validated on a population of university students. Factor analysis demonstrated the existence of three subscales of eight items each: Splitting of Self-Image (“The different parts of my personality are difficult to put together”), Splitting of Family Image (“My feelings about my mother change from day to day”), and Splitting in Others’ Image (“My opinions about my friends rarely change”; reverse item). Items are measured on a Likert scale, from 1 (strongly disagree) to 5 (strongly agree). A mean score is calculated on the score of items for each subscale and for the SI full scale with high total scores representing high levels of splitting. Internal consistency in the initial study was shown to be excellent (α = 0.84–0.90).

The interpersonal RNT is a task designed to assess the impact of interpersonal stimuli on the resolution of PI in working memory and was adapted by Rebetez and colleagues [45]. It was composed of words from several study protocols [29, 46, 47] to ensure for the effect of the valence of words, demonstrating that it does not simply evaluate undifferentiated or rigid thinking” (37), p. 426). In the present study, alpha coefficients for the SI total score indicated an excellent internal consistency (α = 0.89). Reliability for the three scales is generally excellent (i.e., Identity Diffusion: α = 0.84–0.90; Primitive Defense: α = 0.80–0.87; and Reality Testing: α = 0.85–0.87; [40]). In general, structural analyses concur with Kernberg’s theory, showing either a three- or a two-factor instrument in which the functionally related constructs of identity diffusion and primitive defense are combined into one factor (see [41]). The Primitive Defense scale includes splitting (item 69: “I think people are basically either good or bad: there are few who are really in between”) and other related defenses such as idealization (item 57: “There are people that I do not only admire, but almost idealize”). In the present study, the Primitive Defense (PD) total score showed excellent reliability (α = 0.86), permitting the use of the PD scale as a measure of global primitive defenses.

Personality Assessment Questionnaire – Borderline [42]

The French version of the Personality Assessment Questionnaire – Borderline (PAI-BOR) [43] is a 24-item self-report instrument developed to evaluate borderline personality traits and is composed of four subscales with six items each: (a) Affect Instability (e.g., “My mood can shift quite suddenly”), (b) Identity Problems (e.g., “My attitude about myself changes a lot”), (c) Negative Relationships (e.g., “My relationships have been stormy”), and (d) Self-Harm (Impulsivity; e.g., “I sometimes do things so impulsively I get into trouble”). Items are scored on a scale from 0 (false, not at all true) to 3 (very true). A total score is calculated on the items for each subscale and for the PAI-BOR full scale with high total scores representing high levels of borderline features. Reliability for the PAI-BOR subscales is acceptable (as = 0.69–0.81, Morey [43]). Criterion validity of the PAI-BOR, as well as its subscales, was demonstrated in several studies. For example, Stein et al. [44] demonstrated construct validity as participants with a borderline diagnosis scored significantly higher than controls on the total PAI-BOR score. In the present study, the PAI-BOR total score showed excellent reliability (α = 0.88), permitting the use of the PAI-BOR full scale as a measure for borderline personality traits.

Interpersonal RNT

The interpersonal RNT is a task designed to assess the impact of interpersonal stimuli on the resolution of PI in working memory and was adapted by Rebetez and colleagues [45]. It was composed of words drawn from several study protocols [29, 46, 47] to acquire negative (i.e., rejected, betrayed, cruelty, abandoned, loneliness), positive (i.e., included, honest, affection, desired, gener-
ous), and neutral words (i.e., theory, furnished, avenue, loop, practice). Negative and positive words describe negative/positive qualities of social interactions and are presumably salient for individuals with BPD. From these protocols, a list of 16 negative, 16 positive, and 16 neutral were translated into French using a validated back-translation method [48]. Twenty participants who did not participate in the current study were presented with a scale from 1 to 9 and asked to assess the emotional valence (1 = extremely negative; 9 = extremely positive) and the arousal (1 = no emotion; 9 = strongest emotion) of the words (valence average: negative = 2.45, positive = 7.59, neutral = 5.28; arousal average: negative = 5.87, positive = 5.58, neutral = 4.88). All word types (negative, positive, neutral) matched for length (number of letters and syllables), lexical frequency, imagery, and arousal.

The task was composed of negative, positive, and neutral word sets of three sequential words presented on a computer screen. Each word of the set was presented for 750 ms and separated from the next word by an interval of 100 ms. After the third word, a row of number signs was displayed for 400 ms (the retention period) and immediately followed by the presentation of a target word for 600 ms. Participants were asked to indicate, as quickly as possible and without making mistakes, whether the target word was presented in the set of three words of the current trial (yes – positive response trial) or not (no – negative response trial). Figure 1 presents a schematic of the task. Fifty percent (50%) of trials consisted of a target word that was presented in the set of three words of the current trial (positive trials). Twenty-five percent (25%) of trials consisted of a target word that was neither presented in the set of three words of the current trial nor in the set of the three words of the two previous trials (nonrecent negative trials), and 25% of trials consisted of a target word that was not presented in the set of three words of the current trial but occurred in the set of three words of the previous trial (recent negative trials). A total of 240 trials were divided into 3 blocks (one block by condition; i.e., negative, positive, or neutral words) and randomly presented to all participants. There were nine practice trials that were not scored. To avoid any encoding bias effect resulting from the distinctiveness of one type of stimuli among the other types of stimuli [45], all the words in each block (three words set and target) contained the same valence (i.e., negative, positive, or neutral). The criterion validity of the task is

Fig. 1. A schematic of the interpersonal RNT during three trials with words of negative valence. The positive trial consists of a target word that was presented in the set of three words. The recent negative trial consists of a target word that was not presented in the set of three words of the current trial (Trial n) but was presented in the set of the previous trial (Trial n-1). The nonrecent negative trial consists of a target word that was not presented neither in the set of three words of the current trial nor in the set of the previous trial. Each word of the set was presented for 750 ms and separated from the next word by an interval of 100 ms. After the third word, a row of signs was displayed for 400 ms (the retention period) and immediately followed by the presentation of the target word for 600 ms.
well supported. First, there is a robust behavioral effect of recent versus nonrecent negative target on response time and accuracy [34], and this interference effect is correlated with a self-report measure of the dysexecutive syndrome [49]. Also, interference resolution from recent negative trials results in activation in the left inferior frontal cortex, a cerebral region involved in cognitive inhibition (see [33]). Emotional stimuli have been shown to interfere with inhibition capacities, as indicated by higher errors and longer RTs on recent trials compared to nonrecent trials [45].

For each type of words, two PI indexes were calculated. The first PI index was derived from the mean RT, and the second one was based on a CoV [50] obtained by dividing the standard deviation by the mean RT (SD/M) for each participant. This allowed us to obtain a measure of intraparticipant variability. For each condition, the PI index based on the average RT (PI neg RT, PI pos RT, PI neut RT) and the PI index based on CoV (PI neg CoV, PI pos CoV, PI neut CoV) were obtained by subtracting nonrecent negative trials from recent negative trials for each type of words (neg: negative, pos: positive, and neut: neutral). Although the PI index based on mean RT is a measure of cognitive inhibition capacity, the PI index based on CoV is meant to be a measure of the stability of this capacity (i.e., capacity to resist PI in a stable manner through the trials). It is expected that the performance would partly vary according to the emotional impact of the word on the participant. For both indexes (based on RT and CoV), the higher the score, the lower the capacity to resist PI (i.e., the larger the difference between recent and nonrecent negative trials). PI indexes based on the number of errors were not possible in the present study as the average number of errors for each condition was less than 1% (from 0.09 to 0.28) and thus insufficient for analysis.

Procedure
Recruited participants were presented with a brief general description of the study, and they then received an electronic link by email that directed them to the consent form, followed by an electronic version of all questionnaires. In the following days, an appointment was organized for the participant to complete the interpersonal RNT at the university. At the end of each session, participants were asked to assess the valence and the arousal of all words on a 9-point scale, which served as a manipulation check to ensure that all the words are equivalent in terms of arousal, and the negative, positive, and neutral words differ as expected in terms of valence. Participation was entirely voluntary and anonymous.

Data Analysis
All data were obtained for each variable (there was no missing data). All measures showed near normal distributions. Ten extreme outlier participants were observed on several RT variables (3 SD above the mean) and were excluded from the study. The final sample comprised 60 participants (44 females and 16 males). The mean age was 22.0 years (SD = 3.2, range = 18–35), and the level of education (last obtained diploma) varied between high school (11 participants), college (37), and university (12). Thirty-five (35) participants reported to be single, and 25 reported to be in a relationship (married or not). A significant proportion of participants (60%; 36/60) reported having consulted a mental health professional for various reasons (4 participants for a generalized anxiety disorder, 4 for depression, 2 for a personality disorder, 5 for other disorder, and 21 without diagnosis). Moreover, a significant proportion of participants displayed borderline symptomatology equal to or above the typically used PAI-BOR threshold score of 38 (18%, 11/60). The t tests did not show a significant difference between males and females on total SI (t(58) = 1.00, p = 0.32), total PAI-BOR (t(58) = 1.58, p = 0.12), IPO primitive defense (t(58) = −0.11, p = 0.91), or any of the PI indexes (based on the average RT and the CoV). Consequently, gender was not included in regression analyses. Given its significant correlations with all self-reported questionnaires, age was included in regression analyses. The correlation found between splitting and age is coherent with the observation that the scores obtained by patients with BPD on immature defense are significantly diminished over a 16-year period [51].

To explore the different associations between the use of splitting, as measured by questionnaire, and PI indexes, as measured by interpersonal RNT, we used the Pearson product-moment correlation coefficient between all variables. For our first two objectives, we were interested in verifying the existence and the direction of correlations between the use of splitting and both PI indexes (based on the average RT and on the CoV) with negatively and positively valenced relational words. Consequently, we conducted two multiple linear regressions with a forced entry method, which allowed us to choose both PI indexes with negative (first regression) and positive words (second regression) based on Kernberg’s theory of splitting, after controlling for the effect of PI indexes with neutral words, PAI-BOR total score, and IPO primitive defense score. For our third objective, we were interested in verifying whether these different associations with PI indexes are specific to splitting. Consequently, we conducted the same regression analysis, but this time on the prediction of the IPO defense primitive score as a dependent variable and with splitting as a control variable.

The semi-partial correlation was also used to index the unique variance accounted for in a dependent variable by a predictor in the regression analyses. The square of the semi-partial correlation provides an estimate of the actual relative unique variance accounted for by a variable of interest. Preliminary analyses were conducted to ensure that there were no violations of assumptions, linearity, multicollinearity, and homoscedasticity. Finally, two one-way repeated measures ANOVAs were conducted to compare the scores of negative, positive, and neutral words on valence and arousal scales (manipulation check), and a two-way within-subjects ANOVA (recency × valence) was conducted to verify if the interpersonal RNT was an effective measure of resistance to PI and thus show a significant difference in RTs between recent negative and nonrecent negative trials as a function of the valence of the words.

Results
Manipulation Check
During the manipulation check, participants scored all three types of words in the expected direction on the valence scale (from 1 = extremely negative to 9 = extremely positive) and on the arousal scale (from 1 = extremely calm to 9 = extremely excited). One-way repeated measures ANOVAs revealed that there was a significant dif-
ference of valence ($F(2, 58) = 251.81$, $p = 0.000$) and arousal ($F(2, 58) = 13.99$, $p = 0.000$) between the three types of words. Post hoc comparisons indicated that the mean score of valence for negative words ($M = 2.8$, $SD = 0.12$) was significantly different from positive words ($M = 7.3$, $SD = 0.10$) and neutral words ($M = 5.2$, $SD = 0.07$) and that the mean score of valence for positive words was significantly different from neutral words. Post hoc comparisons also indicated that the mean score on arousal for negative words ($M = 5.7$, $SD = 0.22$) was significantly different from positive ($M = 4.6$, $SD = 0.24$) and neutral words ($M = 4.5$, $SD = 0.14$), but there was no significant difference between positive and neutral words. The two-way within-subjects ANOVA (recency x valence) revealed a main effect for recency ($F(1, 59) = 64.00$, $p = 0.000$) and a significant interaction between the recency condition and valence of the words ($F(2, 58) = 3.4$, $p = 0.046$), revealing that mean RTs for recent negative trials were significantly longer than for nonrecent negative trials. Post hoc comparisons indicated that, in recent negative trials, RTs for negative words were significantly longer than neutral words ($F(2, 58) = 2.55$, $p = 0.047$) but not positive words ($p = 0.835$). RTs for positive words tended to be significantly longer than neutral words ($p = 0.066$). Post hoc comparisons also indicated that in nonrecent negative trials, there was no significant difference in RTs for the three types of words. These results suggest that the interpersonal RNT was effective in eliciting PI across the three types of words.

Descriptive Statistics and Correlations

Descriptive statistics for all the measures are shown in Table 2. As can be seen in Table 2, most of the measures were normally distributed with values of skewness and kurtosis under the generally accepted values (i.e., skewness <2 and kurtosis <4; see [52]). Although our focus is on the PI indexes as a measure of cognitive inhibition capacity, we also present the mean RT of recent negative and nonrecent negative trials for each type of word. Correlations are shown in Table 3. The splitting (SI) total score, IPO primitive defense score, and PAI-BOR total were highly correlated. There was a significant and a marginally significant negative correlation between SI and PI indexes based on RT with positive words ($r = -0.310$, $p = 0.016$) and the PI index based on CoV with positive words ($r = -0.225$, $p = 0.084$), respectively. IPO primitive de-

| Measure          | $M$   | $SD$  | Range          | Skew   | Kurtosis |
|------------------|-------|-------|----------------|--------|----------|
| SI               | 56.20 | 16.38 | 27–90          | 0.37   | -0.80    |
| PAI-BOR          | 26.37 | 11.92 | 4–55           | 0.53   | -0.25    |
| IPO prim def     | 35.88 | 10.21 | 17–66          | 0.73   | 0.60     |
| RecN RT neg      | 738.05| 160.18| 538–1,308      | 1.39   | 2.34     |
| NRecN RT neg     | 666.62| 135.72| 447–1,154      | 1.21   | 2.04     |
| RecN RT pos      | 741.83| 175.69| 522–1,355      | 1.68   | 3.38     |
| NRecN RT pos     | 688.39| 156.38| 497–1,181      | 1.46   | 2.16     |
| RecN RT neut     | 705.93| 140.68| 508–1,358      | 1.81   | 6.47     |
| NRecN RT neut    | 665.71| 142.42| 487–1,291      | 1.87   | 5.27     |
| RecN CoV neg     | 0.26  | 0.16  | 0.08–0.90      | 1.75   | 4.02     |
| NRecN CoV neg    | 0.23  | 0.17  | 0.08–0.97      | 2.24   | 5.84     |
| RecN CoV pos     | 0.26  | 0.12  | 0.10–0.55      | 0.91   | 0.09     |
| NRecN CoV pos    | 0.25  | 0.10  | 0.09–0.52      | 0.71   | 0.14     |
| RecN CoV neut    | 0.25  | 0.11  | 0.09–0.61      | 1.21   | 1.87     |
| NRecN CoV neut   | 0.23  | 0.11  | 0.08–0.62      | 1.49   | 2.64     |
| PI index RT neg  | 71.42 | 88.67 | −88 to 421     | 1.37   | 3.69     |
| PI index RT pos  | 53.44 | 69.49 | −140 to 257    | 0.27   | 2.21     |
| PI index RT neut | 46.21 | 63.34 | −133 to 214    | 0.13   | 1.33     |
| PI index CoV neg | 0.02  | 0.21  | −0.63 to 0.58  | −0.50  | 2.65     |
| PI index CoV pos | 0.01  | 0.11  | −0.25 to 0.36  | 0.51   | 1.20     |
| PI index CoV neut| 0.02  | 0.12  | −0.29 to 0.36  | 0.36   | 1.01     |

SI, Splitting Index total score; PAI-BOR, Personality Assessment Questionnaire – Borderline total score; IPO prim def, IPO primitive defense score; RecN, recent negative condition; NRecentN, nonrecent negative condition; RT, reaction time; CoV, coefficient of variation; neg, negative words; pos, positive words; neut, neutral words.
Table 3. Correlations between all variables

|     | SI   | IPOpd | PBt  | PIrt− | PIrt+ | PIrtn | PI CoV− | PI CoV+ | PICVn | Age |
|-----|------|-------|------|-------|-------|-------|---------|---------|-------|-----|
| SI  | 1.0  |       |      |       |       |       |         |         |       |     |
| IPOpd | 0.755**| 1.0   |
| PBt | 0.746**| 0.801**| 1.0  |
| PIrt− | 0.039 | 0.162 | −0.008 | 1.0  |
| PIrt+ | −0.310* | −0.102 | −0.098 | 0.380** | 1.0  |
| PIrtn | −0.205 | −0.191 | −0.124 | 0.266** | 0.129 | 1.0  |
| PI CoV− | 0.149 | 0.120 | −0.059 | 0.753** | 0.137 | 0.272* | 1.0  |
| PI CoV+ | −0.225t | −0.052 | −0.115 | 0.375** | 0.747** | 0.055 | 0.335** | 1.0  |
| PICVn | −0.169 | −0.084 | −0.021 | 0.237t | 0.154 | 0.770** | 0.179 | −0.041 | 1.0  |
| Age  | 0.494** | 0.399** | 0.491** | 0.161 | −0.123 | −0.089 | 0.084 | −0.042 | −0.156 | 1.0  |

SI, Splitting Index total score; IPOpd, IPO primitive defense; PBt, Personality Assessment Questionnaire – Borderline total score; PIrt−, proactive interference index based on mean reaction time with negative words; PIrt+, proactive interference index based on mean reaction time with positive words; PIrtn, proactive interference index based on mean reaction time with neutral words; PI CoV−, proactive interference index based on coefficient of variation with negative words; PI CoV+, proactive interference index based on coefficient of variation with positive words; PICVn, proactive interference index based on coefficient of variation with neutral words.

* p < 0.05; ** p < 0.01; t ≤ 0.10.

Table 4. Multiple regressions examining the SI total score with PI indexes with negative/positive words as predictors and PAI-BOR, IPO primitive defense, PI indexes with neutral words, and age as control variables

|     | Standardized coefficients | Overall model fit |
|-----|---------------------------|-------------------|
|     | β  | pr  | t  | p value | Adj. R² | p value |
| Regr. I: SI | | | | | | |
| PAI-BOR | 0.370 | 0.195 | 2.568 | 0.013* | 0.665 | 0.000** |
| IPOpd | 0.385 | 0.212 | 2.786 | 0.007** | 0.657 | 0.000** |
| PI RT neut | −0.035 | −0.021 | −0.275 | 0.784 |     |         |
| PI CoV neut | −0.073 | −0.044 | −0.581 | 0.564 |     |         |
| PI RT neg | −0.277 | −0.175 | −2.301 | 0.026* | 0.161 | 0.133 | 1.745 | 0.087 |
| PI CoV neg | 0.343 | 0.220 | 2.890 | 0.006** |     |         |
| Age | 0.161 | 0.133 | 1.745 | 0.087 |     |         |
| Regr. II: SI | | | | | | |
| PAI-BOR | 0.329 | 0.183 | 2.380 | 0.021* | 0.657 | 0.000** |
| IPOpd | 0.416 | 0.244 | 3.168 | 0.003** |     |         |
| PI RT neut | 0.033 | 0.020 | 0.264 | 0.793 |     |         |
| PI CoV neut | −0.105 | −0.062 | −0.806 | 0.424 |     |         |
| PI RT pos | −0.190 | −0.118 | −1.542 | 0.129 |     |         |
| PI CoV pos | −0.025 | −0.016 | −0.203 | 0.840 |     |         |
| Age | 0.129 | 0.109 | 1.419 | 0.162 |     |         |

pr, semi-partial correlation coefficients; SI, Splitting Index total score; PAI-BOR, Personality Assessment Questionnaire – Borderline total score; IPOpd, IPO primitive defense; PI RT neg, proactive interference index based on mean reaction time with negative words; PI RT pos, proactive interference index based on mean reaction time with positive words; PI RT neut, proactive interference index based on mean reaction time with neutral words; PI CoV neg, proactive interference index based on coefficient of variation with negative words; PI CoV pos, proactive interference index based on coefficient of variation with positive words; PI CoV neut, proactive interference index based on coefficient of variation with neutral words.
fense and the PAI-BOR total score were not significantly correlated with any PI indexes.

Regression Analyses

To verify whether PI indexes (based on RT and CoV) with negative words predict the SI total score above and beyond the PAI-BOR total score, IPO primitive defense score, PI indexes (based on RT and CoV) with neutral words, and age as control variables, a first multiple regression was performed. As shown in Table 4, the model explained 67% of the variance in the SI score, and PAI-BOR total score, IPO primitive defense score, PI index based on RT, and PI index based on CoV made a significant and unique contribution to its variance. It is worth noting that the IPO primitive defense score made the largest contribution ($\beta = 0.385$) and that both PI indexes with negative words made a similar but reverse contribution: the beta coefficient is negative for the PI index based on RT ($\beta = -0.277$) and positive for the PI index based on CoV ($\beta = 0.343$). Taking together, these results indicate that the PI index based on RT and PI index based on CoV with negative words make a significant contribution in explaining 3% and 5% of the variance in the SI score, respectively (pr values: $-0.175$ for the PI index based on RT and $0.220$ for the PI index based on CoV), independently from the contribution of the PAI-BOR total score and IPO primitive defense score. In other words, the frequency of SI is associated with a stronger but less consistent capacity to resist PI with negative words.

To verify whether PI indexes with positive words predict SI above and beyond the PAI-BOR total score, IPO primitive defense score, PI indexes with neutral words, and age as control variables, a second multiple regression was performed. The model explained 66% of the variance in the SI score, but only the PAI-BOR total score ($\beta = 0.329$) and IPO primitive defense score ($\beta = 0.416$) made a significant and unique contribution to the variance.

Finally, to verify whether the contribution of PI indexes with negative and positive words was specific to splitting in comparison with a global measure of primitive defenses, the same multiple regression analyses were conducted but this time on the IPO primitive defense score as the dependent variable and the SI total score as the control variable. As shown in Table 5, the first model including PI indexes with negative words explained 70% of the variance in IPO primitive defense score, and the second model including PI indexes with positive words explained 66% of the variance. In both models, only the SI total score (negative words: $\beta = 0.343$; positive words: $\beta = 0.395$) and PAI-BOR total score (negative words: $\beta = 0.578$; positive words: $\beta = 0.532$) made a significant and unique contribution to the variance in IPO primitive defense score.

| Table 5. Multiple regressions examining the IPO primitive defense score with PI indexes with negative/positive words as predictors and SI total score, PAI-BOR, PI indexes with neutral words, and age as control variables |
|--------------------------------------------------|
| **Standardized coefficients** | **Overall model fit** |
| | $\beta$ | $pr$ | $t$ | $p$ value | $\text{Adj. } R^2$ | $p$ value |
| **Regr. I: IPOpd** | | | | | | |
| PAI-BOR | 0.578 | 0.347 | 4.837 | 0.000** |
| SI total | 0.343 | 0.200 | 2.786 | 0.007** |
| PI RT neut | $-0.123$ | $-0.074$ | $-1.038$ | 0.304 |
| PI CoV neut | 0.019 | 0.011 | 0.159 | 0.875 |
| PI RT neg | 0.210 | 0.130 | 1.814 | 0.076t |
| PI CoV neg | $-0.018$ | $-0.010$ | $-0.145$ | 0.885 |
| Age | $-0.095$ | $-0.077$ | $-1.074$ | 0.288 |
| **Regr. II: IPOpd** | | | | | | |
| PAI-BOR | 0.532 | 0.329 | 4.403 | 0.000** |
| SI total | 0.395 | 0.237 | 3.168 | 0.003** |
| PI RT neut | $-0.117$ | $-0.072$ | $-0.958$ | 0.343 |
| PI CoV neut | 0.084 | 0.050 | 0.665 | 0.509 |
| PI RT pos | $-0.023$ | $-0.014$ | $-0.190$ | 0.850 |
| PI CoV pos | 0.123 | 0.078 | 1.040 | 0.303 |
| Age | $-0.053$ | $-0.044$ | $-0.584$ | 0.562 |

See Table 3.
fense score. However, it is worth noting that the PI index based on RT with negative words made a marginally significant and unique contribution to the variance in the IPO primitive defense score ($\beta = 0.210$, $p = 0.076$).

Discussion

According to Kernberg’s theory [12], splitting refers, from a structural point of view, to the segregation of positive and negative valence of self and object representations and, from a process point of view, to the active separation of these representations in order to avoid contamination of positive object relations by negative object relations in the person’s subjective experience (see [9]). The purpose of the present study was to better understand the cognitive processes associated with splitting. Specifically, the main goal was to test whether splitting was related to a cognitive inhibition process called RPI whose function is to prevent mental representations that are no longer relevant to the task at hand from entering working memory. This goal was answered separately according to the positive and negative valence of the relational words used in the RNT. The first objective was to test whether RPI with relational words of negative valence predicted splitting beyond BPD features, primitive defenses, and neutral valence words. Three alternative hypotheses were expected regarding the relationship between the PI index score (higher index reflects weaker capacity for RPI) and the SI score. According to a first hypothesis, a positive correlation would characterize the relation between splitting and the PI index, indicating that splitting is related to a weakness in the RPI. According to a second hypothesis, a negative correlation would characterize the relationship indicating that splitting is related to an RPI capacity. According to a third hypothesis, it was expected that splitting is related to a fluctuation in RPI performance. The second objective was to repeat the same analyses but this time with words representing positive valence interactions. The final objective was to test whether the expected relationship between splitting and RPI is similarly observed with a general measure of primitive defenses. Results supported the second and third hypotheses of the first objective and suggest that splitting is both related to an RPI capacity and to a difficulty in maintaining this capacity in the context of relational words of negative valence. Results did not show a relationship between splitting and RPI when the relational words were of positive valence. Finally, results showed that RPI does not significantly predict primitive defenses beyond BPD features, splitting, and neutral valence words, suggesting that this cognitive inhibitory function is more specifically related to splitting.

Regarding the first objective, results showed that the PI index with negative valence words is negatively correlated with splitting, while the CoV of the PI index is positively related. These results suggest that splitting is related to a capacity to inhibit words of negative valence from entering in working memory and also to a weakness in maintaining this function consistently over time. In general, the results support past studies demonstrating that RPI capacity is impaired in BPD patients when stimuli are of negative valence or involve a BPD theme [29, 30]. The results of the present study extend these data by showing that deficits in maintaining RPI apply to splitting more specifically. At the theoretical level, it is possible to see the relationships between splitting and RPI as reflecting a similar relational reality between two different circumstances, namely before and after a relational frustration (see Table 1). Before the relational frustration, the patient’s subjective experience is occupied by positive object relations and therefore requires inhibition of negative object relations from entering working memory. The negative relationship between the PI index and splitting would possibly reflect this circumstance. Conversely, following a frustration, negative object relations invade the person’s subjective experience and contaminate positive object relations. The relationship between the CoV of the PI index and splitting would reflect this fragility to maintain a constant inhibition on negative object relations according to the circumstances.

Regarding the second objective, results did not demonstrate that splitting is related to RPI with positive valence words. There may be methodological and theoretical reasons for these results. From a methodological viewpoint, the manipulation check about the arousal and valence of words used in RNT indicated that the mean score on arousal for negative words was significantly higher than positive and neutral words. Based on research showing a relationship between physiological arousal and subjective evaluation of emotional intensity (see [53]), it is possible to interpret the reported arousal triggered by the negative words as an index of the emotional intensity the participants experienced. As such, compared to that of positive words, the stronger emotional intensity associated with negative words made it possible to obtain a sufficiently large deleterious effect on the resistance to PI. Furthermore, on a methodological level, using positive words to activate positively split representations is questionable. Indeed, according to Kernberg’s theory [12], splitting prevents the development of representations of self and of
others from becoming more nuanced and that is why positive representations remain idealized in nature. Our RNT did not include relational words of positive valence that were likely to activate idealized representations.

The lack of relationship between splitting and RPI with words of positive valence can also be explained on a theoretical level. According to Kernberg’s theory, negative object relations are dominant in the personality structure of BPD patients, and this is precisely one of the reasons why splitting is used to prevent their contamination effect on positive object relations. Thus, on the defensive level, it is reasonable to believe that splitting serves to protect the patient against negative object relations as opposed to positive object relations. On the motivational level, the patient wishes to protect themself against negative object relations which are sources of suffering and behavioral disorganization, whereas positive object relations are sources of gratification produced by the pleasure felt in the interactions between the self and the other. When negative object relations are present in working memory, that is, before gratification, there is no reason to believe that the client needs to inhibit positive object relations from entering working memory. Conversely, after a gratification, positive object relations are present in working memory, and it is possible to believe that the inhibition is not aimed at positive object relations but at negative object relations, the circumstances described above. This is coherent with the view that splitting is used as a shield that protects against an excessively hostile intrapsychic world [54].

In summary, regarding Kernberg’s definition of splitting as referring to an active separation between positive and negative object relations [12], the results of the present study suggest that this defensive function would be achieved in different ways depending on the valence of the representations. Rather than seeing splitting as related to the inhibition of positive and negative object relations to keep them separate, it is possible to break down splitting into functional and structural components. Functionally, splitting is related to the inhibition of negative object relations leaving the subjective experience characterized by positive object relations. When the patient’s subjective experience is flooded by negative object relations, this situation would not be the result of inhibition of positive object relations but rather a reflection of the lack of integration in the positive and negative valence of object relations, that is, object relations that are polarized and felt on the subjective level as intense and univalent negative object relations.

Regarding the third objective, the results indicating that primitive defenses are not significantly related to RPI suggest that the relationships between splitting and RPI are specific to this latter defensive function and do not apply more generally to the category of defense associated with borderline personality organization. Furthermore, the marginally significant prediction of RPI on primitive defenses is manifested by a positive beta value (β = 0.210) between the PI index with words of negative valence and primitive defenses suggesting that, unlike splitting, primitive defenses are associated with a general weakness in RPI capacity. This positive beta value between the PI index and primitive defenses corroborates Hoermann and collaborators’ study [31] which showed that BPD patients with low effortful control capacity are also those who make use of primitive defenses.

In a more general way, the present study wants to contribute to the rapprochement between psychoanalytical constructs and cognitive neurosciences by establishing the relationship between splitting and RPI. From the results obtained, it is possible to formulate new hypotheses that could be investigated in future experiments. First, the results of the present study clarify the links that were expected in Gagnon and collaborators’ model [28] between splitting and RPI by suggesting that those relationships cannot be seen in the same way for positive and negative object relations. Furthermore, by clarifying the relationships between splitting and the PI index with negative words, it is possible to propose some hypotheses regarding the neurobiological correlates of splitting. In short, according to Kernberg’s model [12], splitting is characterized by split object relations eliciting intense emotional responses, by the segregation of negative and positive object relations, and by a defensive motivation affecting especially the awareness of the emotional aspects of the split representations related to the attitudes and behaviors that were enacted in past circumstances. In his essay on the neurobiological correlates of object relations, Kernberg [22] puts forward the idea that split object representations would be related to subcortical limbic development of separate positive and negative affective systems. Notably, the amygdala would be involved in the activation of negative affects and the nucleus accumbens and the tectum in that of positive affects, whereas the hippocampus would be involved in the registration and preservation of the affective memory, which is composed of units of the self and the object representations under the dominance of negative versus positive affect activation. The integration of the positive and negative affective systems would take place at a higher level, namely in the prefrontal cortex and at the junction of the orbitofrontal cortex and the cingulate cortex.

An alternative way of considering the role of the amygdala in splitting would be as a structure involved in the
activation of both positive and negative affective memory. Indeed, a current conception of the role of the amygdala in BPD is that this structure would not be specifically related to the processing of threatening stimuli but would be more generally associated with the processing of stimuli relevant to the individual’s motivations according to their current psychological state [55]. According to Cunningham and Brosch’s model [56], activation of the amygdala would not only be associated with negative stimuli but also to ambiguous, novel, and positive stimuli. Specifically, when a stimulus is identified as relevant to the individual, activation of the amygdala makes that stimulus more salient and intense, it facilitates its access to awareness, and increases the level of alertness in order to promote an adaptive response to changes in the environment (i.e., relational frustration vs. gratification).

When this conceptualization is transposed to the level of object relations, it is possible to believe that this function of the amygdala does not only apply to external stimuli but also to internal stimuli that are internalized object representations activated by external stimuli. In the case of BPD patients, the hyperactivation of the amygdala that is reported following the presentation of negative or ambiguous stimuli would reflect in part the motivational value that these stimuli represent in terms of their negative object relations. This activation would lead the individual to process in a preponderant way the negative internalized object relations to the detriment of other information such as the memories of the positive affects, representations, behaviors, and attitudes that the individual has demonstrated during the moments of gratification with the external object. The prefrontal cortex would be necessary to modulate the activation of the amygdala and would allow the entire individual’s psychological state to be taken into consideration. Conversely, the circumstances of gratification would make the positive object relations more salient in the patient’s subjective experience. The defensive aspect of splitting would take place during these circumstances of gratification by allowing, in addition to the effects of salience of the amygdala on the positive object relations, an inhibition effect of the prefrontal cortex on the negative object relations. Although present in BPD patients, this inhibition function would remain fragile and dependent on the changing circumstances of the social environment. fMRI studies following relational frustration versus gratification would permit to verify whether a measure of splitting correlates positively or negatively with amygdala activation.

This study has limitations. The main limitation concerns the use of a questionnaire to measure splitting. The relationships observed between the resistance to PI and splitting do not make it possible to establish causal relationships or ensure that splitting (as measured in this study) is a defense process that is activated in a situation that is threatening to the self or to determine whether it occurs before or after increases in anxiety that result from integrating representations of opposite valence. To study splitting directly, it is necessary to develop experimental conditions that promote its occurrence. There is no assurance that presenting words that are either positive or negative in valence can meet these conditions. More studies are needed to study splitting in situ. The other limitation concerns our sample, which largely consisted of participants who did not present with BPD. It is possible that the absence of a significant relationship between the resistance to PI and the positive words can be explained by the likelihood that for individuals who are nonclinical, splitting is characterized by good and bad evaluations that are less extreme, and thus, oscillations between representations are less rapid, which makes sense given that these representations are more nuanced in terms of valence [57]. Finally, given its exploratory nature, the results of this study must be interpreted with caution and need to be replicated before concluding that they have a heuristic value, both scientifically and with regard to theoretically integrated treatment (e.g., [58]) that may be offered to individuals with symptoms of polarization and fluctuations in perception of self and others.

In conclusion, this study was intended to contribute to the research of splitting and to efforts to clarify its related cognitive components. Results obtained in this study support the relationship between splitting and resistance to PI. More specifically, the present study proposes that splitting is associated with both a capacity of RPI and a weakness in maintaining the inhibition of negative representations from entering working memory, which occurs after a social frustration. More studies are needed to corroborate these results.

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Statement of Ethics

The research was undertaken with the understanding and written consent of each participant, and the study has been independently reviewed and approved by the Comité d’Éthique de la Recherche en Psychologie et en Education (CEREP; reference number: CERAS-2018-19-100-D).
Conflict of Interest Statement

The authors have no conflicts of interest to declare. The findings reported in this manuscript have not been previously published, and the manuscript is not being simultaneously submitted elsewhere.

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Author Contributions

Jean Gagnon conceptualized the study, collected and analyzed the data, and wrote and revised the manuscript. Gasser Saleh developed the research protocol, collected and analyzed the data, and revised the manuscript. Joyce Emma Quansah and Charles Levin revised the manuscript. Jean Gagnon, Joyce Emma Quansah, Gasser Saleh, and Charles Levin have approved the submitted version of this manuscript.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
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