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MOOD DISORDERS (E BACA-GARCIA, SECTION EDITOR)

Distress, Suicidality, and Affective Disorders at the Time of Social Networks

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Abstract

Purpose of Review We reviewed how scholars recently addressed the complex relationship that binds distress, affective disorders, and suicidal behaviors on the one hand and social networking on the other. We considered the latest machine learning performances in detecting affective-related outcomes from social media data, and reviewed understandings of how, why, and with what consequences distressed individuals use social network sites. Finally, we examined how these insights may concretely instantiate on the individual level with a qualitative case series.

Recent Findings Machine learning classifiers are progressively stabilizing with moderate to high performances in detecting affective-related diagnosis, symptoms, and risks from social media linguistic markers. Qualitatively, such markers appear to translate ambivalent and socially constrained motivations such as self-disclosure, passive support seeking, and connectedness reinforcement.

Summary Binding data science and psychosocial research appears as the unique condition to ground a translational web-clinic for treating and preventing affective-related issues on social media.

Keywords Social media · Affective disorders · Depression · Suicidal behaviors · Distress

Introduction

In the 1990s, the emergence of the first social network sites (SNS) opened the web 2.0 area by allowing web users to easily interact with each other and share digital contents via public or semi-public profiles [1]. Since then, the digital social universe dramatically extended, connecting up to 2.6 billion people worldwide in 2018 [2]. With a mean daily consumption of more than 2 h and a half [2], SNS engage people into an online social life regulated by its own habits, codes, and rules, reconfiguring the way they reveal, communicate with, and relate to each other.

Emotional displays and expressions of distress are fully concerned by this generational transformation. SNS created an unprecedented interaction space between vulnerable individuals and society. The online space enabled new ways for distressed people to share their feelings, seek support, interact, or receive help. At the same time, SNS provided the scientific community with an unprecedented insight in how people may reveal symptoms in public spaces.

For a period, scholars have relied on some observations that mood disorders are overrepresented among SNS users to suggest the depressogenic effects of social networking [3,

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4•]. The issue appeared so compelling that some proposed to isolate specific morbid categories, such as "Facebook depression" [5••]. However, inconsistencies in empirical findings have been revealed more and more [4•, 6] and put into question the naturalization temptation. The idea emerged that the way people use SNS was of a greater predictive importance than SNS use per se [7]. Authors thus attempted to delineate maladaptive patterns of social networking that could be a predisposition to affective alterations. The notion of "problematic social network use" was progressively accepted as encompassing a wide range of at-risk online behaviors [6, 8, 9•], all characterized by unusual concerns and excessive use of SNS leading to functional life alterations [10•].

Since then, research has delved into the characteristics of the relationship between psychological distress and social media use. In addition to acknowledging its qualitative variations, the literature conclusively discarded reductionistic approaches [11] by unveiling three major properties of the association: (1) bi-directionality, as social networking may influence people's mental health, while, reciprocally, distress may alter the way people use SNS [8, 12]; (2) indirection, as various mediating factors, such as cyberbullying, have been found to explain part of the effects that SNS have on users' mood [3]; (3) ambivalence, as SNS may potentially have both positive and negative affective consequences [4•, 12]. Those observations provide a crucial glimpse of the complex interaction that binds SNS to mood disorders. Rather than a statistical linear dependency, this promotes a more holistic point of view in which social networking is considered in depressed or distressed individuals as a genuine socio-affective conduct [10•].

In the present paper, we critically review the two distinct—yet complementary—strategies that have been adopted so far to address the complexity of the interaction between SNS and altered mood, namely (1) using purely data-driven approaches to detect distressed individuals while circumventing explanatory matters and (2) exploring the motivations, functions, and consequences of going on SNS, connecting and posting online contents in depressed or suicidal people. To confront literature findings with "real-life" idiosyncratic behaviors, we further present a qualitative multiple case report of individuals who posted Facebook messages before a suicidal crisis.

Detecting Altered-Mood Individuals Behind the Mass of Social Media Data

From the outset, psychiatric research efforts dedicated to social media have been structured around the major axis of detection. The ambition is to identify, behind the mass of contents published and shared daily, those SNS users who suffer from or are the most at risk of a given condition. Along with other psychiatric conditions [13–16], the detection of affective disorders has recently benefitted from the crucial advances of data sciences. In short, data scientists have endeavored to answer two interwoven questions: (1) what are the digital communication markers of distress? (2) How much may these markers help distinguishing destressed individuals from the general population of SNS users?

The Language of Distress

To portrait the typical language of altered mood, authors have mined the active contributions of digital users known (based on self-assessments or self-declaration) or considered (based on forum membership or expert opinion) to suffer from an affective, anxiety, or suicidal issue [17]. In a categorical diagnostic perspective, depressive digital language was found to be characterized by the typical themes of self-hatred, loneliness, suicide, death, and self-harm [18•]. It was also evidenced to contain more negative affective words and display more feelings of hopelessness or worthlessness than non-depressive language (see the review by [19]). In a more dimensional perspective, Guntuku et al. reported that stressed users were also prominently self-focused, but published more specifically contents suggestive of lack of control, need states, or lack of resources [17]. They also referred to themes related to exhaustion, hurt, physical pain, feeling of sickness, or loss of control. Finally, data scientists evidenced some typical linguistic patterns in suicide-related posts, such as higher word count, increased use of first-person pronouns, prepend and multifunction words, references to death, and lower usage of verbs [20•, 21]. Note that people who attempted suicide tend to refer to suicide after rather than before the act [22].

Principles and Performances of Currently Available Classifiers

From the detection point of view, mass data produced in the SNS space is both a hurdle and a chance. As illustrated by tragical recent news stories (see for instance [23]), the continuous flow of digital information almost precludes human detection and regulation. On the other hand, mass information enables purely data-driven approaches to be used, thus relaxing the hypothesis-testing constraints and reducing the detection noise due to the random variations of language. In the supervised machine learning framework, detection is equivalent to train an algorithm to classify people from their digital productions. The performance of each classifier is evaluated by its ability in detecting individuals among all distressed users (recall), in lowering the proportion of erroneously detected individuals (precision) and in maximizing both precision and recall (as reflected by the F-index or by the area under the receiver operating characteristic—ROC—curves).

With regard to affective issues, machine learning techniques have been applied to diagnosis such as depression or

seasonal affective disorders [24], symptoms such as distress and suicidal ideations [20, 25], and self-threatening behaviors such as suicide attempts [22]. Detection performances on SNS vary greatly, depending on the prevalence of the outcome, the statistical model, or the nature of the training dataset and features [26]. Several authors trained classifiers to detect suicidal individuals from sets of features extracted from microblogs (Twitter, Weibo) forums and/or blogs productions. Lv et al. [25] and Burnap et al. [27••] found optimal precision rates ranging from about 0.50 to 0.65, recall rates from 0.40 to 0.75, and F-index from 0.5 to 0.69. Cheng et al.'s classifier was characterized by a ROC area under curve of 0.60 [20]. With respect to depressive disorders, Guntuku et al. reviewed seven studies that tested the performance of machine learning algorithms in detecting self-assessed or self-declared depressed Twitter and Facebook users [26], and reported a ROC area under curve ranging from moderate (.70) to high (.91). Finally, with a semi-supervised machine learning algorithm, Coppersmith et al. correctly predicted from their posts the status of 70% of Twitter users who attempted suicide [22].

Interestingly, recent computational step forwards indicate new directions for machine learning to gain in predictive accuracy with respect to affective and suicidal matters: integration of risk factors [28, 29], better insights in the online translation of causal paths [28], and better account of the dynamic nature of affective and suicidal issues [29].

The Motivations and Functions of Social Networking for Altered-Mood Individuals

Self-Disclosure

Self-disclosure on the SNS is paradoxical by nature. On the one hand, any published post reaches a broad and partially uncontrolled audience, even when the author was initially aiming at making intimate confidence [19]. Consequently, self-disclosure on SNS implies important self-exposure to social judgment, which distressed individuals usually avoid offline [30•]. On the other hand, several characteristics of online communication provide SNS spaces with an appearance of safety, intimacy, and privacy: avatars and pseudonyms allow users to freely shape virtual identities, asynchrony and immateriality alleviate the self-presentational concerns related to spontaneity and physical reality, and the absence of interpersonal immediate feedback, including para-verbal clues, relaxes the interlocutory imperative of communication [18•, 31, 32].

The resulting blur between the private and public vocation of the SNS space [33] appears particularly efficient in relieving the stigma that usually deter distressed people from making self-engaging social contributions. As noted by Park et al., research indeed found depressed individuals to share personal information online more frequently than healthy users [34••]. Perhaps more surprisingly, the self-disclosure facilitation effect of SNS does not specifically benefit expressions of suffering or altered mood, as distressed individuals post roughly the same number of positive and negative contributions than non-distressed users [19]. Similarly, depressive symptoms were proved unrelated to negative disclosure on Facebook [34••].

One possible explanation of the relative paucity of stress posting (i.e., online posting of negative thoughts [3]) may lie in the ambivalent motivations of depressed individuals when revealing themselves online [19], as a result of a motivational conflict. On the one hand, distressed SNS users may be buoyed by the rewarding consequences they can expect from disclosing their mood. To that respect, Radovic et al. provided interesting qualitative insights in why depressed adolescents occasionally publish negative contents [3]. Beyond the implicit reward that intrinsically comes with online self-presentation [35], interviewed adolescents reported that self-disclosure helped them in regulating their emotion and developing their identity, while serving at passively eliciting social support (see the "Support Seeking" section). On the other hand, SNS can amplify the self-presentational concerns of depressed individuals [19]. Public social network interactions are governed by the principle of diffraction. Messages are non-directionally distributed to the community, thus increasing the number of possible commenters. At the same time, the online disinhibition effect [36], as well as the minimally engaging forms of possible reactions (emoticons, likes, short comments), may explain that SNS users more easily and spontaneously respond to each other's publication—including sometimes harshly or malevolently. From a probabilistic standpoint, online interactions augment the risk that disturbing self-disclosure messages will lead to negative consequences, which tend to validate depressed individuals' beliefs. Apprehensions mostly relate to displaying an unfavorable image of self, unwillingly impacting relatives or receiving negative social feedbacks [19].

Interestingly, some authors described inherently dysfunctional forms of self-disclosure, either due to excessive frequency (a condition a.k.a. "oversharing") or to inadequate content (nudes and other suggestive pictures, sex-posting, self-harm or threatening messages, etc.). From a motivational perspective, inappropriate self-disclosure habits could be ascribed to impaired decision-making, possibly resulting from decision bias or imbalance in the risk/benefit estimation in vulnerable people [37–39]. Unfortunately, as dysfunctional self-disclosures infringe the norms of online social communication, they may cause hostile or inappropriate reactions, such as disapproving feedback, mockery, criticism, communication

overload, and, in the most structured and severe cases, cyberbullying [3, 40].

Support Seeking

At-risk individuals are increasingly going online for mental health issues [41••] and broadcast suicidal messages [29]. However, very few are those who actively seek support on SNS. According to Chan et al., about 70% of youth have ever expressed distress on social networking platform [42•], but only one-fifth have sought help (either formal or informal). Yet, contrary to what happens offline [43], negative self-disclosure has been found to actually generate strong support of the community [3, 34••]. Because of the overlap between private confessions and public messages, self-disclosure on SNS thus offers distressed users with an opportunity to elicit support in a way that is more affordable and apparently less engaging than active help-seeking. As one of the most worrisome form of passive support seeking, Berryman et al. found that "vaguebooking"—a communication modality that consists in posting unclear but alarming sounding posts to get attention—was significantly predictive of suicidal ideations in young adults [7].

The social value of disclosing distress online without explicit interpellation appears to mostly consist in activating, and perhaps checking the responsiveness of social latent social ties [34••]. In fact, not only were digital "friends" and "followers" proven responsive to signs of distress but their reactions were also found mostly supportive, especially for depressed users [34••]. The generally benevolent reactivity of the community could be expected particularly beneficial to isolated (self-)stigmatized and help-reluctant populations, such as LGBT+ [44], youth [45••], and suicidal individuals [41••].

However, research has highlighted a striking incongruence between the actual support received by depressed individuals in the digital social environment and the resulting subjective benefits. As reported by Park et al., persons suffering from depression perceive themselves as receiving less Facebook social support than their non-depressed counterparts and report more negative experiences during online social interactions [34••]. A straightforward account could be that the negative social perception bias known to affect depressed individuals [46, 47] may translate or even be magnified on SNS. Due to strong negative representations of self, users with altered mood may remain impervious to mismatching—often stereotypical—online positive feedbacks [19]. It is also possible that anonymity and shallow relationships exacerbate tendencies for erroneous inferences about other's intentions [19], leading to suspicion about the authenticity of supportive messages.

The actual consequences of online social support on users' mood remain poorly known. As noted by Radovic et al. [3], there are clues for equivocal effects, with some individuals reporting positive outcome [48, 49], and others feeling paradoxically worse about themselves, less confident, and more depressed [48]. Such counter intuitive observation may relate to a disappointment effect, where online support is insufficient to meet depressed users' expectations of social recovery, due to their inability to internalize positive feedbacks [3].

Connectedness

Formally, digital connections differ from offline relationships by the low level of personal commitment they require. Virtual "friendships" on Facebook or Snapchat are as easy to create than to undo, resulting in globally labile social links. Also, contrary to offline life, social networks authorize purely unilateral relationships, such as on Instagram or Twitter where one can follow the account of someone who may totally ignore him/her. As a result of the new forms of inter-individuals ties, social networks grew and organized in non-random patterns.

Structural network analysis shed worthwhile lights on the architectural properties of the networks within which distressed users are embedded. By exploring the friends, followers, and repost patterns of 3535 Twitter users who published suicidal contents, Colombo et al. evidenced that the digital participants benefitted from a strong social capital, mostly made of mutual relationships with other suicidal users [50••]. The resulting clustering effect leads to the spontaneous formation of what could be called "suicidocosms," i.e., sub-communities of suicidal users tightly associated to each other but relatively isolated from the rest of the net. As a digital translation of suicidal individuals' propensity for homophily [51], such typical structure has important functional consequences on how information circulates within the network. Colombo et al. evidenced optimal conditions for quick and high level of propagation, which breeds ground for suicidal contagion and broadcast of disturbing contents [50]. The tight interconnectivity between suicidal individuals fosters the recursive circulation of emotionally loaded information, while paucity of communication paths to the rest of the net deprives the suicidocosms from alternative forms of information. This can result in a co-rumination effect [52] which is known to worsen depression and anxiety symptoms [53].

Connectedness was repeatedly evidenced to be a strong protective factor for both affective disorders and suicidal behaviors [54, 55]. A number are distressed web users who go online to seek a community to relate to, or to restore a sense of belonging that have been thwarted offline. Noteworthily, Baker and Algorta [4•] noted that depressed individuals tend to present a specific appetence for online networking, as suggested by their greater tendency to accept former partners' invitations to become Facebook friends, and to engage in interactive communication on Facebook, as compared with healthy users.

However, connectedness is not only about how one is structurally bound to the community but has also to deal with a strong subjective component, namely how he/she appraises this connection. Apparently, the qualitative characteristics of social networking could exacerbate the subjective benefits of connectedness [54]: SNS facilitates affiliation and could initially reinforce the feeling of belonging, which may have positive consequence on self-confidence. Likewise, the high reactivity of the community to negative self-disclosures reinforces the impression of collective responsibility for each of its members. Finally, the appearance-relying modes of communication vehicle strong normative models to which it is easy to conform, thus reinforcing the feeling of belonging. The literature provides several hints that social network connectedness may have beneficial effects on the general population [12, 56].

However, in the specific population of depressed users, SNS interactions may reveal their double-edge sword potential. First, the strong normative constraints of the online social life seem to turn a burden for already vulnerable individuals, as depressed people were found to have a strong—sometime unintentional—tendency for painful social comparison [3, 12]. Second, the SNS combine most of the predisposing conditions for maladaptive behaviors to contagiously spread. On the online space, self-threatening messages and pictures that are often presented in a trivial or glamour way raise massive interest [18]. They convey the implicit message that disclosing risky behaviors bring social recognition and eases integration. Vulnerable individuals may identify to users who depict self-harm or suicidal behaviors as normative models of how to gain self-esteem and better relate to the group. Finally from a structural point of view, highly homophilic environments, as suicidocosms are, proved particularly vulnerable to contagious phenomena [57]. Taken together, these observations could explain that negative mood [58], self-harm, and suicidal behaviors [59] are at high risk of contagiously spreading over the net.

Qualitative Multiple Case Report

The abovementioned general findings are summarized in Fig. 1.

In order to gain insights into how they may personify at the individual level, but also to raise further hypothesis in the clinical and psychosocial determinants of how and why distressed people self-disclose on SNS, we conducted a qualitative multiple case study including 8 persons admitted to emergency department (ED) after a suicide attempt or for severe suicidal ideations. Participants were recruited in the University Hospitals of Montpellier and Nîmes (France), between January and June 2017 (characteristics presented in Table 1). They consented to grant access to their Facebook account, so that we recorded all the posts they published within the 3 months prior to their admission. Facebook posts were broken into units of meaning and submitted to qualitative annotation. Two researchers independently created and assigned labels to the units reflecting the sense of the content. Two further investigators (CEN and MM) discussed the relevance of the labels and resolved possible disagreements between the annotators. When the saturation of the data was reached, we classified the final list of labels into categories of conceptual proximity. The study received the International Review Board number IRB 2019_IRB-MTP_07-12.

As shown in Table 2, 56 labels emerged, divided into 12 categories. The relatively balanced representation of categories of both positive and negative valence immediately stands out. Negative semantic contents related to themes classically attributed to individuals with altered mood such as subjective pain or negative perception of self and others, but also to themes more specific of suicidal individuals, such as exhaustion. References to mental health disorders and suicide announcement were rare (present in only 1 post). Perhaps more surprisingly, participants clearly referred to positive resources, either internal, external, or social (connectedness). Finally, the more neutral categories were either purely descriptive (utterances) or suggestive of special preoccupation for time passing or social normative pressure.

Two types of participants can be distinguished from the posting timeline presented in Fig. 1. Participants 1, 3, 4, and 8 mostly posted messages within the month before their admission to the ED or the suicide attempt. Information contained in the messages was generally rich and ambivalent, with a balanced redundancy of both positive and negative semantic contents within the same posts. The amount of messages increased in the last 10 days before the outcome, suggesting a link with the suicidal process. By contrast, participants 2, 5, 6, and 7 posted no or few messages in the month prior the admission/suicide attempt, but some in the 2 months before. Their messages were relatively poor in information and generally positive and/or neutral in valence. In these individuals, the posting pattern appeared idiosyncratic and uncorrelated with the suicidal crisis.

The right panel of Fig. 2 illustrates the overall representation of thematic categories within each participant. In almost all SNS users, the palette of positive categories was richer than these of negative and positive categories. This unequal balancing could reflect the individuals' ambivalence between their will for disclosing suffering and their strive to present with a favorable self-image. Alternatively, it could be that distressed users enumerate the variety of positive resources they have been depleted from, resulting in relatively stereotypical subjective experience of pain and exhaustion. Finally, presentation of

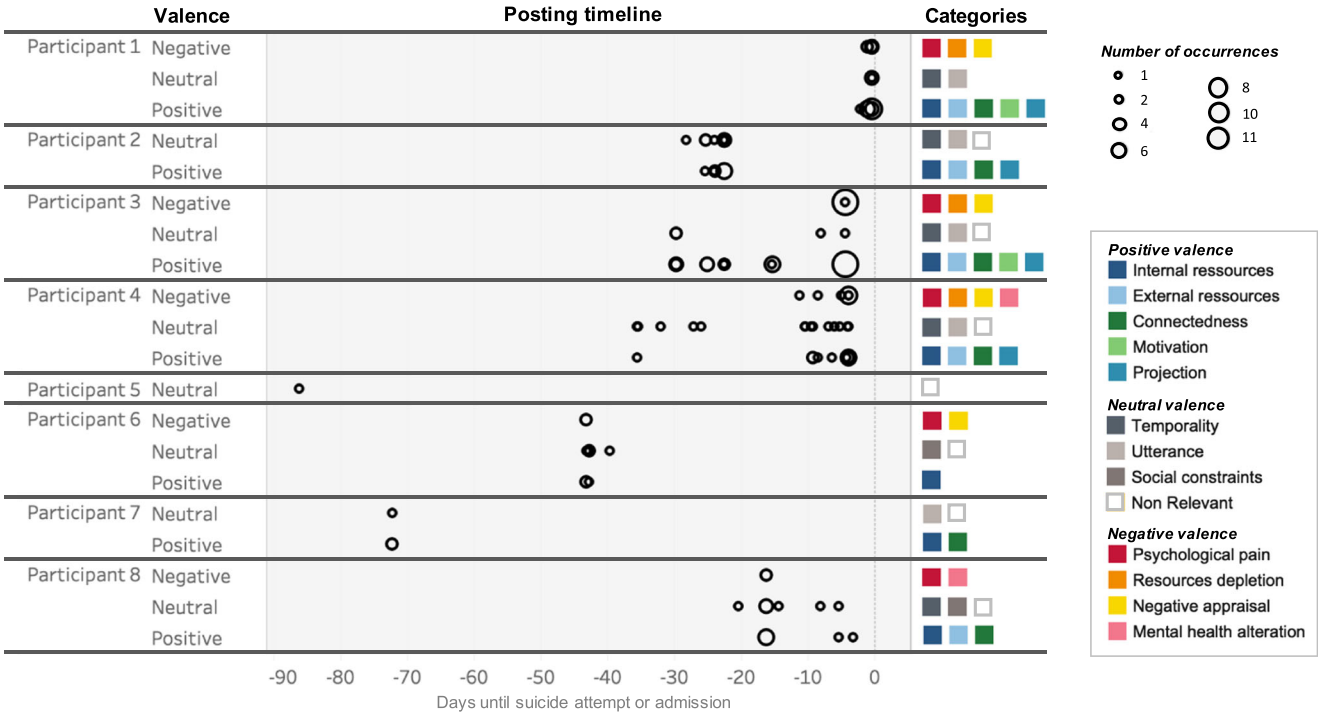

Fig. 1 Schematic synthesis of current understandings about the motivations, functions, and consequences of using online social media for distressed individuals. Stress posting (i.e., posting contents where the author discloses more or less explicitly his/her distress) results for an approach (+)/avoidance (−) motivational balance that integrates self-disclosure, connectedness, and passive help-seeking functions. The disruptive nature of the stress-posts contributes to determine the reaction of the community, which, in turn, influences the motivational balance of the users. The linguistic characteristics of the distress-related posts are the basic material that machine learning methods use to detect at-risk individuals. Finally, connectedness-seeking in distressed individuals often leads to the formation of highly homophilic "suicidocosms" where information circulates quickly and recursively. This may have adverse consequences such as co-rumination or suicidal contagion

Table 1 Clinical and sociodemographic characteristics of the participants

	Gender Age	Social status	Outcome	Diagnosis	History of SA
Participant 1	Male 21 yo	Single Employed	SA (cutting)	Adjustment disorder	No
Participant 2	Female 51 yo	Married Employed	SA (intoxication)	Type II bipolar disorder Current major depressive episode	Yes
Participant 3	Female 56 yo	Divorced Employed	SI	No diagnosis	No
Participant 4	Male 17 yo	Single Student	SI	Borderline personality disorder	Yes
Participant 5	Female 28 yo	Single Unemployed	SA (intoxication)	Major depressive disorder Borderline personality disorder	Yes
Participant 6	Female 25 yo	Single Student	SI	Anorexia nervosa Major depressive disorder Borderline personality disorder	Yes
Participant 7	Female 18 yo	Single Student	SA (intoxication)	Major depressive disorder Panic attacks	No
Participant 8	Female 55 yo	Divorced Disabled	SA (intoxication)	Bulimia nervosa Major depressive disorder Borderline personality disorder Type I bipolar disorder	Yes

SA, suicide attempt; *SI*, suicidal ideations; *yo*, years old

Table 2 Labels and categories identified from the qualitative analysis of Facebook posts, organized according to their valence

	Label	Verbatim
Negative valence	*Psychological pain*	
	Anxiety	Always this anxiety that rots my life
	Tiredness	I'm just a little tired
	Fear of judgment	I'm afraid that you say you hate me or something like that
	Self-deprecation	That's why my life does not matter
	Loneliness	Solo
	Fear of judgment	But I try not to disappoint you
	Sadness	Your silent cries will not hush up your pain
	Loss of meaning	My life without you does not make sense anymore
	Impression of being misunderstood	Nobody can understand unless getting through it
	Negative consequences of the past	My childhood and today I still have some aftermath
	Guilt	Sorry for all my mistakes
	Powerlessness	Despite all this I realize that you are not so happy
	Resource depletion	
	Unbearable	Ran out of what I can bear
	Limits reached	Despite I do not have strength or energy anymore
	Negative appraisal	
	Negative life experience	We both have had more downs than ups
	Disbelief	At first, I could not believe it
	Negative observation for others	Despite all this I realize that you are not so happy
	Mental health alteration	
	Drug and alcohol	You think I'm drunk but I'm not
	Announcement of suicidal attempt	I am dying
	Psychiatric diagnosis	Admission of bipolarity or other scar
Positive valence	*Internal resources*	
	Personal commitment	After lots of efforts
	Coping strategy	We resisted everything
	Need for self-disclosure	Let your great collapse speak
	Resilience	But I try to get better
	Mark of humor	lol and chimps in all of this ?🤔
	Humility	Humbly, from my brush to my painting
	Tolerance	Valid different or disabled, we are humanity quite simply
	Introspection	Those are my two "I" - conscious/unconscious
	Satisfaction	It was a nice trip in your company
	Excitement	H-24 🌧😍 #RatatouilleIsBack 🐀💥
Positive valence	*External resources*	
	Leisure or cultural activities	A book is a book. But whatever the book, it is good to read.
	Social support	My relatives from whom I receive support
	Inter-personal commitment	But today I fight for both of us
	Highlighting of protective factors	the only thing that still keeps me standing is my children
	Awareness of inter-personal resource	Despite what I did, you still have the strength to be with me
	Connectedness	
	Expression of feelings for others	I love you my heart…
	Invitation to social exchange	Who wants to participate ??
	Display of affection for others	Proud of my adorable children
	Interpellation	For you sweetie Jennifer V*.
	Family tie	At my son's and my stepdaughter's
	Social activity	For the Valentine's day I organize a diner for single folks

Table 2 (continued)

	Label	Verbatim
	Motivation	
	Emotional cost	After lots of efforts
	Reason for action	You help me to keep moving forward
	Reward	I see the reward ;)
	Projection	
	Prospect of relief	I will finally find peace
	Hope	For us to have a wonderful life
	Projection into the future	Bob* is my bro'. I know I will always be able to count on him
Neutral valence	*Temporality*	
	Progression	They grew so fast - family, you will recognize yourself
	Waiting	There is not much time left
	Daily life	Every morning, I wake up with a singe question in my mind
	Utterance	
	Living environment	This ball in in the station is beautiful
	Life sequence	My baby going on vacation
	Memory	Memories💙🌴🌟✺
	Social constraints	
	Appearance	I dressed reasonably with a uniform
	Normativity	Nothing was to exceed and everything should be standard
	Duality	Ybride Personality Psychopath...

*For confidentiality reasons, names have been changed

resources to the community may be a mirror of the participants' internal coping strategy face to the overwhelming distress. To that respect, it is interesting to note that every individual referred to internal resources, and almost all of them expressed subjective pain.

Conclusions

With regard to affective disorders and suicidal behavior research, interest in SNS has known a remarkable expansion. Mounting evidence consensually highlights the need—if not the urgency—to act towards distressed users. At the same time, recent technological advances allow to contemplate the full use of SNS in integrative prevention and/or therapeutic strategies.

At the population level, public health could find a way to indirectly monitor the rates of affective disorders and suicidal behaviors using the predictive value of social network data. This would allow for more agility and reactivity than what traditional epidemiological methods allow for. Instances of how the so-called infodemiology can be used to measure the actual impact of possibly distressing public events is getting increasingly common [60, 61]. Also, SNS could serve as a mass medium for universal prevention messages to increase literacy about affective disorders and/or promote access to care. As suggested by emerging computational evidence [62••], such online broadcast could have decisive effects in counteracting the spread of negative emotion or self-harm contents.

On the individual level, SNS could be leveraged to improve access to care for ambivalent distressed individuals who cannot or do not want to afford formal appointments with health professionals. Thanks to its interactional properties, SNS could serve as a gateway to mental healthcare by alleviating most of the help-seeking barriers. Ideally, the gateway strategy would require clinicians to work directly on SNS, provide a first response, and reinforce users' motivation to progressively engage in a more formal therapeutic process [63]. With a further degree of proactivity, emerging performance of data mining methods allow to consider outreach strategies [21]. Online monitoring or repeated mass screening of social data streams could inform professionals of most at-risk users. By making direct contact in response to their alarming posts, clinicians could offer those individuals a decisive opportunity to resolve ambiguity and engage in the help process [29, 64].

Although promising, these perspectives raise important technical, scientific, clinical, and ethical concerns [24, 33,

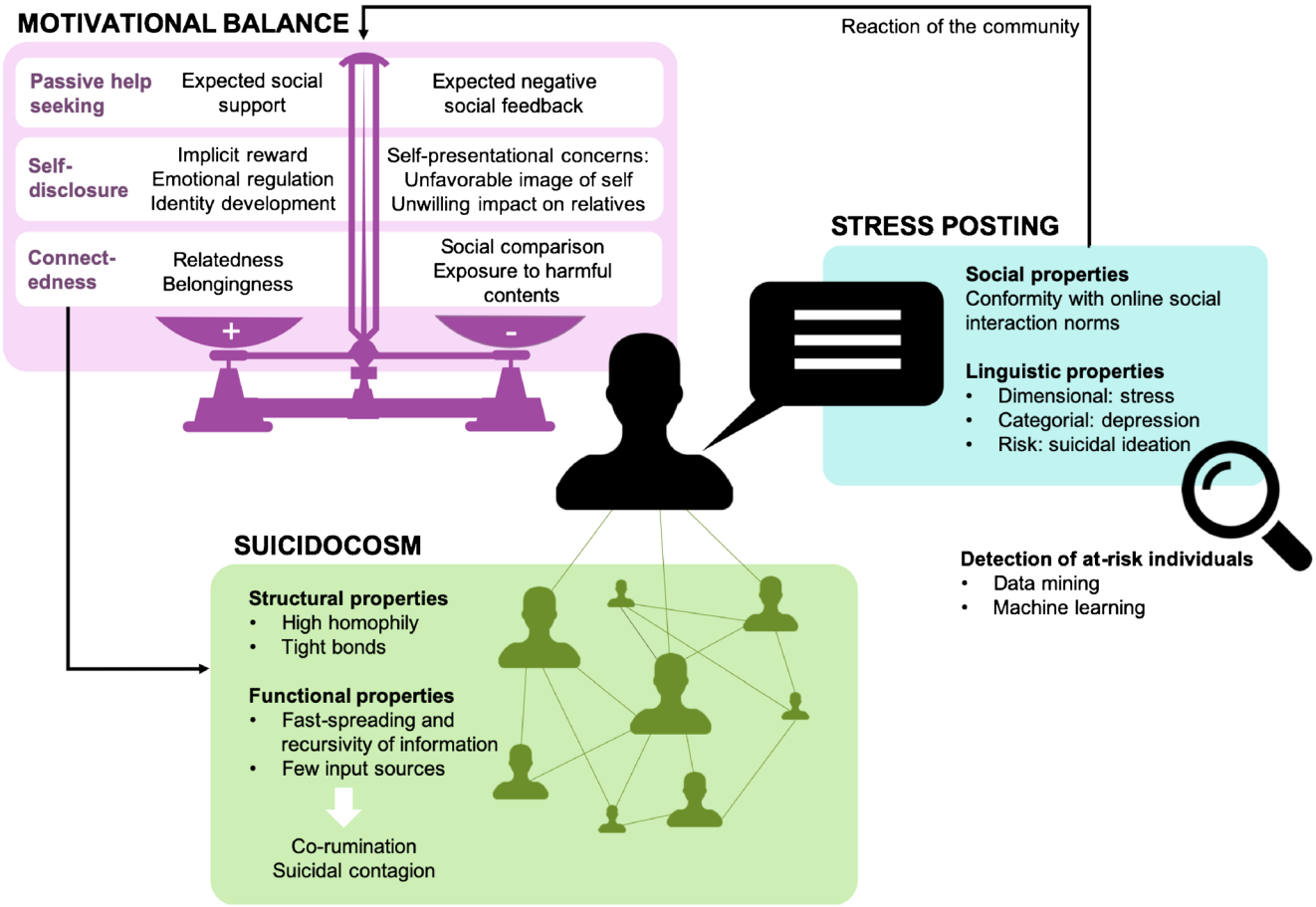

Fig. 2 Representation of the posting timeline and thematic categories within each participant, depending on the valence of the categories. Time 0 represents either the time of admission to the emergency department for participants with suicidal ideations (3, 4, and 6) or the time of the suicide attempt (participants 1, 2, 7, and 8). The size of the circle is proportional to the number of thematic occurrence within a given post, suggesting redundancy in the information

63, 65••]. Unfortunately, the literature still damagingly lacks empirical evidence to enable safe and efficient prevention via SNS. Following other authors [45], we argue that one of the major hurdles before the actual implementation of in situ online mental health services for distressed users lies in the compartmentalization of data sciences and psychosocial research. By definition, machine learning dissociates linguistic elements from their context and underlying intentions. Recognizing that SNS distress markers are not only material to train classifier, but also the condensed and elusive products of conflicting motivations and constraints are a necessary condition for developing tailored optimal approaches, help offering, and eventually, prevention. Our multiple case report illustrates the complex, ambiguous, and embedded psychological and psychopathological processes that may hide behind the digital productions of each distressed individual. Although clear advances have been achieved to open the machine learning "black-box," deeper qualitative insights into the dynamic interplay between the social online environment and distressed and/or depressed individuals are required to translate population-level findings into individual-level interventions. Undoubtedly, integrating macro-individual mining with the understanding of individuals' motivations, needs, social relations, and expectations is the difficult task that prospective "web-clinicians" will have to face [24, 63].

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Human and Animal Rights and Informed Consent Informed consent was obtained from all individual participants included in the study.

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- •• Of major importance

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