Assessment of Stress-Buffering Effects of Uplift Events on Overwhelmed Teenagers from Microblogs

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Abstract

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1. Introduction

Stress. Life is always full of ups and downs. The serious mental health problems caused by stress has become hot issues that are widely concerned around the world. According to the newest report of American Psychological Association, the youngest adults are most likely of all generations to report poor mental health in America, and 91 percent of Gen-Zs between ages 18 and 21 say they have experienced physical or emotional symptom due to stress in the past month compared to 74 percent of adults overall (APA, 2018). Accumulated stress comes from daily hassles, major stressful events and environmental stressors could drain people's inner resources, leading to psychological maladjustment, ranging from depression to suicidal behaviours (Nock et al., 2008). Nowadays more than 30 million Chinese teenagers are suffering from psychological stress, and nearly 30% have a risk of depression (Youth and Center, 2019).

Stress-buffering. Restoring is an essential process in human's stress coping system (Susan, 1984) to help get out of overwhelmed status. Traditional psychology research shows that stress-restoring could function through various ways, including exercise[xx], self-esteem [xx], changing environments [xx], chatting with friends [xx], writing diaries [xx] and so on. The specific restoring restoring mode remains to be further explored.

With the epidemic of social media among adolescents, it provides a new channel for timely and non-invasive exploration of users' mental health status. Previous studies have shown that it is feasible and reliable to detect user's psychological stress and stressor events, and predict future psychological stress trends through social network data. However, research on stress-buffering effects of uplift events from social networks still calls for more exploration. This article will explore the restoring impact of uplift events from microblogs, help scheduling positive interventions, and predict future stress.

2. Literature review

2.1. *Restorative function of positive life events.*

Positive life events are conceptualized as exerting a protective effect on emotional distress in psychological literature (Cohen et al., 1984; Needles and Abramson, 1990). Many psychological researchers have focused on the restorative function of positive events with respect to physiological, psychological, and social coping resources. (Folkman and Moskowitz, 2010) identified three classes of coping mechanisms that are associated with positive emotion during chronic stress: positive reappraisal, problem-focused coping, and the creation of positive events. The author also considered the possible roles of positive emotions in the stress process, and incorporated positive emotion into a revision of stress and coping theory in the work (Folkman, 1997). They conducted a longitudinal study of the care giving partners of men with AIDS and described coping processes that were associated with positive psychological states in the context of intense distress.

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The protective effect of uplift events was hypothesized to operate in both directly (i.e., more positive uplift events people experienced, the less distress they experience) and indirectly ways by 'buffering' (Cohen and Hoberman, 2010). In the direct way, the more positive uplift events people experienced, the less distress they experience. While in the indirectly way, positive life events play its role by buffering the effects of negative events on distress. A pioneer experiment conducted by Reich and Zautra provided enlightening evidence for us (Shahar and Priel, 2002). In this experiment, sampled college students who reported initial negative events were encouraged to engage in either two or twelve pleasant activities during one-month, and compared with students in the controlled group experiencing no pleasant activities. Results indicated that participants in the two experimental groups reported greater quality of life compared with controlled students, and participants who engaged in twelve uplift events exhibited lower stress compared with whom engaging two or none uplifts, implicating the protective effect of uplift events on adolescents.

H1: Positive events could buffer teen's psychological stress.

Positive events are verified as protective factors against loneliness, suicide, daily stressors, depression and helping improve health. (Chang et al., 2015) investigated the protective effect of positive events in a sample of 327 adults, and found that the positive association between loneliness and psychological maladjustment was found to be weaker for those who experienced a high number of positive life events, as opposed to those who experienced a low number of positive life events. This is assistant with the conclusion made by (Kleiman et al., 2014) that positive events act as protective factors against suicide individually and synergistically when they co-occur, by buffering the link between important individual differences risk variables and maladjustment. Through exploring naturally occurring daily stressors, (Ong et al., 2006) found that over time, the experience of positive emotions functions to assist high-resilient individuals to recover effectively from daily stress. In the survey made by (Santos et al., 2013), strategies of positive psychology are checked as potentially tools for the prophylaxis and treatment of depression, helping to reduce symptoms and for prevention of relapses. Through a three-week longitudinal study, (Bono et al., 2013) examined the correlation between employee stress and health and positive life events, and concluded that naturally occurring positive events are correlated with decreased stress and improved health.

Due to the immature inner status and lack of experience (Vitelli, 2014), young people exhibit more exposure to uplift events compared with adults, such as satisfying social interactions, excellent academic performance and pleasant entertainments. Researchers indicate that positive events mitigate the relation between negative events and maladjustment in samples of adolescents experiencing family transitions (Doyle et al., 2003). The written expression of positive feelings has also be shown to prompt increased cognitive re-organization among an undergraduate student group (Coolidge, 2009). Positive uplifts can not only help reinforce adolescents' sense of well-being, help restore the capacity for dealing with stress, but also have been linked to medical benefits, such as improving mood, serum cortisol levels, and lower levels of inflammation and hyper coagulability (Jain et al., 2010). Through examining the relationship between self-reported positive life events and blood pressure in 69 sixth graders, researchers found that increased perceptions of positive life events might act as a buffer to elevated blood pressure in adolescents (Caputo et al., 1998).

H2: High frequency of positive events better relieve stress.

2.2. Assessment of Stress-buffering Effects of Positive Events

Measuring the Impact of Uplift Events with traditional psychology scales. To measure the impact of uplift events, Doyle *et al.* Kanner et al. (1981) conducted *Hassles and Uplifts Scales*, and concluded that the assessment of daily hassles and uplifts might be a better approach to the prediction of adaptational outcomes than the usual life events approach. Silva *et al.* Silva et al. (2008) presented the *Hassles & Uplifts Scale* to assess the reaction to minor every-day events in order to detect subtle mood swings and predict psychological symptoms. To measure negative interpretations of positive social events, Alden *et al.* Alden et al. (2008) proposed the interpretation of positive events scale (*IPES*), and analyzed the relationship between social interaction anxiety and the tendency to interpret positive social events in a threat-maintaining manner. Mcmillen *et al.* Mcmillen and Fisher (1998) proposed the *Perceived Benefit Scales* as the new measures of self-reported positive life changes after traumatic stressors, including lifestyle changes, material gain, increases in selfefficacy, family closeness, community closeness, faith in people, compassion, and spirituality. Specific for college students, Jun-Sheng *et al.* Jun-Sheng (2008) investigated in 282 college students using the *Adolescent Self-Rating Life Events Checklist*, and found that the train-

ing of positive coping style is of great benefit to improve the mental health of students. Previous exploration for the protective effect of uplift events on adolescents are mostly conducted in psychological area, relying on traditional manpower-driven investigation and questionnaire. The pioneer psychological researches provide us valuable implications and hypothesis, while limited by labor cost, and single questionnaire based method.

Sensing adolescent stress from social networks. With the high development of social networks, researches explored applying psychological theories into social network based stress mining, offering effective tools for adolescent stress sensing. As billions of adolescents record their life, share multi-media content, and communicate with friends through such platforms, e.g., Tencent Microblog, Twitter, Facebook and so on, researchers tend to digging psychological status from the self-expressed public data source. Xue *et al.* Xue et al. (2014) proposed to detect adolescent stress from single microblog utilizing machine learning methods by extracting stressful topic words, abnormal posting time, and interactions with friends. Lin *et al.* Lin et al. (2014) construct a deep neural network to combine the high-dimensional picture semantic information into stress detecting. Based on the stress detecting result, Li *et al.* Li et al. (2015)adopted a series of multi-variant time series prediction techniques (i.e., Candlestick Charts, fuzzy Candlestick line and SVARIMA model) to predict the future stress trend and wave. Taking the linguistic information into consideration, Li *et al.* Li et al. (2017a) employed a NARX neural network to predict a teen's future stress level referred to the impact of co-experiencing stressor events of similar companions. To find the source of teens' stress, previous work Li et al. (2017b) developed a framework to extract stressor events from microblogging content and filter out stressful intervals based on teens' stressful posting rate. All above pioneer work focused on the generation and development of teens' stress, providing solid basic techniques for broader stress-motivated research from social networks. Based on such research background, this paper starts from a completely new perspective, and focuses on the buffering effect of positive events on restoring stress. Thus we push forward the study from how to find stress to the next more meaningful stage: how to deal with stress.

H3: Positive events could predict teen's future stress.

3. Current study

In this paper, we aim to continually mine the restoring impact of uplift events leveraging abundant data source from microblogs, to further provide guidance for school and parents that when and which kind of uplift events could help relieve students' overwhelmed stress in both stress prevention and stress early stopping situations. To model such a practical application problem, several challenges exist. 1) How to extract uplift events from microblogs and identify corresponding impact interval? The impact of uplift events is highlighted when the teen is under stress, with various relative temporal order. Extracting such scenarios from teen's messy microblogs is the first and basic challenge for further analysis. 2) How to qualitatively and quantitatively measure the restoring impact conducted by uplift events? There are multiple clues related to teens' behaviours from microblogs, i.e., depressive linguistic content, abnormal posting behaviours. The teen might act differently under similar stressful situations when the uplift event happens or not. It is challenging to find such hidden correlation between uplift events and teen's behavioural characters.

Moreover, for different types of uplift events, the restoring impact might be different. And for each individual, the protective and buffering effect for stress might also varies according to the personality. All these questions guide us to solve the problem step by step.

In this paper, we first conduct a case study on real data set to observe the posting behaviours and contents of stressful teens under the influence of uplift events. We conduct the case study on the real data set of 124 high school students associated with the school's scheduled uplift and stressor event list. Several observations are conducted to guide the next step research. Next, we extract uplift events and the corresponding impacted interval from microblogs. We define and extract structural uplift events from posts using linguistic parser model based on six-dimensional uplift scale and LIWC lexicons. Independent stressful intervals (SI) and stressful intervals impacted by uplifts (U-SI) are extracted considering temporal orders. To quantify the restoring impact of uplift events, we describe a teen's stressful behaviours in three groups of measures (stress intensity, posting behaviour, linguistic), and model the impact of uplift events as the statistical difference between the sets of SI and U-SI in two aspects: the two-sample based method is employed for variation detection, and the t-test correlation is conducted to

judge the monotonous correlation.

4. Study1: Observation on the stress-relieving ability of school scheduled uplift events

4.1. Sample

We built our dataset based on two sources: 1) the microblogs of students coming from Taicang High School, collected from January 1st, 2012 to February 1st, 2015; and 2) list of scheduled school events, with exact start and end time. We filtered out 124 active students according to their posting frequency from over 500 students, and collected their microblogs throughout the whole high school career. Totally 29,232 microblogs are collected in this research, where 236 microblogs per student on average, 1,387 microblogs maximally and 104 posts minimally.

Uplift events and stressor events. The list of weekly scheduled school events (from February 1st, 2012 to August 1st 2017) are collected from the school's official website [1], with detailed event description and grade involved in the event. There are 122 stressor events and 75 uplift events in total. Here we give the examples of scheduled uplift and stressor events in high school life, as shown in Table 1. There are 2-3 stressor events and 1-2 uplift event scheduled per month.

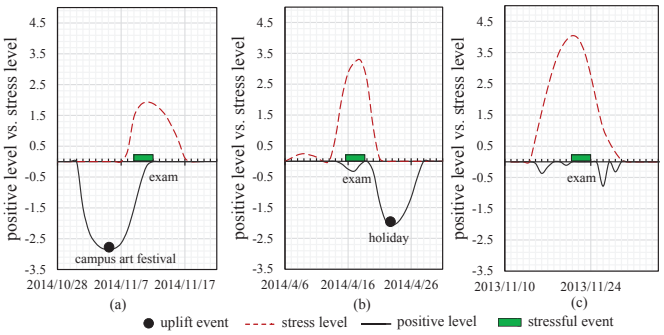
Table 1: Examples of school scheduled uplifts and stressor events.

Type	Date	Work Content	Grade
stressor event	2014/4/16	*first day of mid-term exam*	grade1,2
uplift event	2014/11/5	*campus art festival*	grade1,2,3

Stress detected from microblogs. Since our target is to observe the restoring impact of uplift events for teenagers under stress. Based on previous research Xue et al. (2013), we detected the stress level (ranging from 0 to 5) for each post; and for each student, we aggregated the stress during each day by calculating the average stress of all posts. The positive level (0-5) of each post is identified based on the frequency of positive words (see Section 5 for details). Figure 1 shows three examples of a student's stress fluctuation during three mid-term exams, where the uplift event *campus art festival* was scheduled ahead of the first exam, the uplift event *holiday* happened after the second exam, and no scheduled uplift event was found nearby the third

[1] http://stg.tcedu.com.cn/col/col82722/index.html

Figure 1: Examples of school related stressor events, uplift events and a student's stress fluctuation



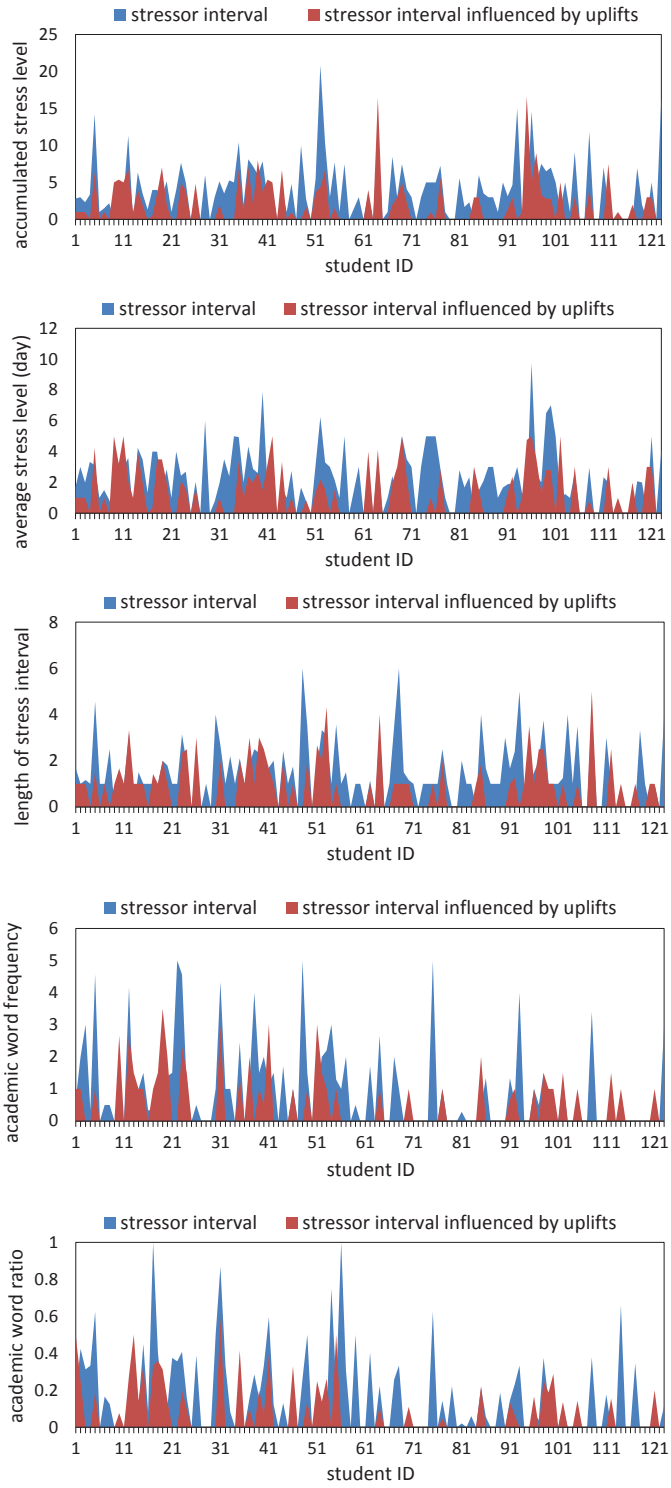
exam. The current student exhibited differently in above three situations, with the stress lasting for different length and with different intensity.

To further observe the influence of uplift events for students facing stressor events, we statistic all the stressful intervals Li et al. (2017b) detected surround the scheduled examinations over the 124 students during their high school career. For each student, we divide all his/her stressful intervals into two sets: 1) stressful intervals under the influence of neighbouring uplift events (e.g., *Halloween activity*), and 2) independent stressful intervals. Figure 2 shows five measures of each student during the above two conditions: the *accumulated stress*, the *average stress* (per day), the *length of stressful intervals*, the *frequency of academic topic words*, and the *ratio of academic stress among all types of stress*. For each measure, we calculate the average value over all eligible slides for each student.

4.2. Findings

Comparing each measure in scheduled exam slides under the two situations: 1) existing neighbouring uplift events or 2) no neighbouring scheduled uplift events, we find that students during exams with neighbouring uplift events exhibit less average stress intensity (both on accumulated stress and average stress), and the length of stress slides are relatively shorter. Further, we statistic the frequency of academic related topic words for each exam slide (as listed in Table 2), and look into the ratio of academic stress among all five types of stress. Results in Figure 2 shows that most students talked less about the upcoming or just-finished exams when uplift events happened nearby, with lower frequency and lower ratio. The stress intensity and type distribution detected from each student's microblogs

Figure 2: Compare students' stress during exam intervals in two situations: 1) affected by neighboring uplift events (U-SI), 2) no uplift events occurred nearby (SI)



varies due to personal life experience, posting habits and express styles. The statistic result shows clues about the stress-relieving ability of scheduled uplift events, and thus helps shape our problem as how to quantify the influence of uplift events, thus to provide further guidance for planning campus activities to help relive students' stress effectively.

Table 2: Examples of academic related topic words.

exam, fail, review, score, grade, test paper, rank, pass, math, chemistry homework, recite, regress, fall behind, tension, stressed out, physics, nervous, mistake, answer, question, puzzle, difficult, lesson, careless

5. Study2: Find the restoring pattern of uplift events

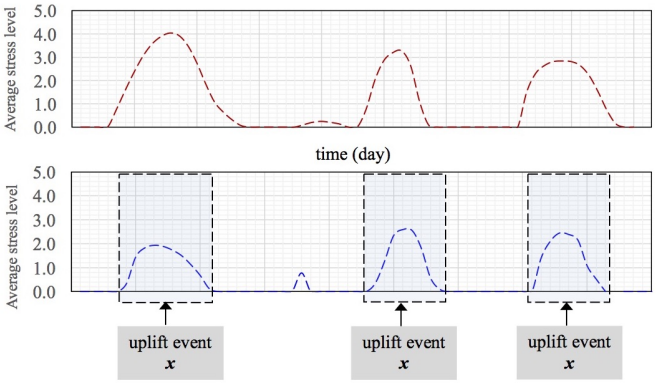
Based on the observation and psychological theory (Cohen et al., 1984; Cohen and Hoberman, 2010; Needles and Abramson, 1990), we conduct our research under the assumption that uplift events can ease teenagers' stress, namely the positive restoring impact of uplift events. While stressor events stimulate human's stress, uplift events bring positive influence and stronger restoring ability to stressed people in various situations with multi-types.

Taking the three stress curves in Figure 1 for example, comparing the stress curves *a)*, *b)* with *c)*, when an uplift event (*campus art festival, holiday* here) happens, the overall stress intensity during the stressful period is reduced. An uplift event might happen before a teen's stress caused by scheduled stressor events (*example a*), conducting lasting easing impact; Meanwhile, an uplift event might also happen during (*example b*) or at the end of the stressful period, which might promote the teen out of current stressful status more quickly. To study the restoring impact of an uplift event, we structure its impact from three aspects:

Impact interval of uplifts. To study the impact of uplift events from microblogs, two fundamental factors are identifying the exact time when the uplift event happens, and the corresponding stressful interval it impacts. The temporal order between uplift events and the teen's stress series varies in different situations, and its a challenge to match the uplift event to the right stressful interval it actually impacts.

Restoring patterns of uplifts. As the restoring impact of uplift events relieves the teen's stress and exhibits in multiple aspects (e.g., the changes in posting behavior, linguistic expression,

Figure 3: Illustration of SI and U-SI stressful intervals.



and stress intensity from microblogs), it's meaningful to extract the stress-related restoring patterns and describe the restoring impact of uplift events structurally.

Quantified impact of uplifts. Different types of uplift events might conduct restoring impact with different intensity. In this paper, the ultimate problem we target to solve is how to quantify the restoring impact both qualitatively and quantitatively from teenagers microblogs.

Given an uplift event with specific type, we consider its restoring impact by comparing the teen's behavioral measures under two situations. As illustrated in Figure 3, in the original situation (i.e., sub-series A), the teen's stress is caused by a stressor event, lasting for a period, and no other intervention (namely, uplift event) occurs. We call the set of such stressful intervals as **SI**. In the other comparative situation (i.e., sub-series B), the teen's stressful interval caused by the same type of stressor is impacted by an uplift event with type x, we call the set of such stressful intervals as **U-SI**. Thus the difference under the two situations SI and U-SI could be seen as the restoring impact conducted by the uplift event of type x.

Next, we give the formal definition for uplift events and stressor events from the perspective of linguistic structure.

Uplift event. Let $u = [type, \{role, act, descriptions\}]$ be an uplift event, where the element *role* is the subject who performs the *act*, and *descriptions* are the key words related to u. According to psychological scales Kanner et al. (1981); Jun-Sheng (2008), teenagers' uplift stressors mainly focus on six aspects, as $\mathbb{U}$ = {*entertainment', 'school life', 'family life', 'pear relation', 'self-cognition', 'romantic'*}, $\forall u, u._{type} \in \mathbb{U}$.

Stressor event. Similar to stressor event, let $e = [type, \{role, act, descriptions\}]$ be a stressor event. According to psychological questionnaires Kanner et al. (1981); Yan et al. (2010); Jiang (2000); Baoyong and Ying (2002), we classify stressor events into five types, as $\mathbb{S}$ = { *'school life', 'family life', 'pear relation', 'self-cognition', 'romantic'*}, $\forall e, e._{type} \in \mathbb{S}$.

The examples of teens' microblogs describing uplift events and stressor events are listed in Table 3 and Table 4. For the post '*I have so much homework today!!!*', its elements are *role = 'I', act='have', descriptions = 'homework'*, and the *type = 'school life'*. For the post '*Expecting Tomorrow' Adult Ceremony[Smile][Smile]* ', we translate it into *act = 'expecting', description = 'Adult Ceremony'*, and the *type = 'self-cognition'*.

Table 3: Structured extraction of positive events from microblogs.

I am really looking forward to the spring outing on Sunday now. (Doer:*I*, Act:*looking forward*, Object:*spring outing*)
My holiday is finally coming [smile]. (Doer:*My holiday*, Act:*coming*, Object:*[smile]*)
First place in my lovely math exam!!! In memory of it. Object:*first place, math, exam, memory*)
You are always here for me like sunshine. (Doer:*You*, Object:*sunshine*)
Thanks all my dear friends to take the party for me. Happiest birthday! (Doer:*friends*, Act:*thanks*, Object:*party, birthday*)
I know my mom is the one who support me forever, no matter when and where. (Doer:*mom*, Act:*support*)

Table 4: Structured extraction of stressor events from microblogs.

I don't know how long can I bear the nag. (Doer:*I*, Act:*bear*, Object:*nag*)
Parents like to judge everything around me with their emotion. (Doer:*parents*, Act:*judge*, Object:*everything*)
Every one betrayed me. (Doer:*every one*, Act:*betray*, Object:*me*)
I'm too weak to handle such a fierce competition. (Doer:*I*, Act:*too weak to handle*, Object:*competition*)
When can you be aware of my heart-broken feeling again and again? (Doer:*you*, Act:*be aware of*, Object:*heart-broken feeling*)

Problem. : For an uplift event u with type U', a stressor event e with type S', let F:$(u, U', e, S') \rightarrow \boldsymbol{A}$ ($\boldsymbol{A}$ is a multidimensional vector) be the restoring influence of uplift event u conducted on the stress caused by stressor event e. We aim to quantify such influence $\boldsymbol{A}$ from multiple views.

6. Addition

Study1.

Method.

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