Altered Positive Affect in Clinically Anxious Youth: The Role of Social Context and Anxiety Subtype

Judith K. Morgan[1], **Grace E. Lee**[1], **Aidan G.C. Wright**[2], **Danielle E. Gilchrist**[1], **Erika E. Forbes**[1,2,3], **Dana L. McMakin**[4], **Ronald E. Dahl**[5], **Cecile D. Ladouceur**[1], **Neal D. Ryan**[1], and **Jennifer S. Silk**[1,2]

[1]University of Pittsburgh, Department of Psychiatry

[2]University of Pittsburgh, Department of Psychology

[3]University of Pittsburgh, Center for Neural Bases of Cognition

[4]Florida International University, Department of Psychology

[5]University of California, Berkeley, Department of Public Health

Abstract

Anxious youth may experience altered positive affect (PA) relative to healthy youth, perhaps because of greater sensitivity to social experiences. Altered PA may be especially evident during the transition to adolescence, a period in which positive social events increase in salience and value. The current study evaluated whether anxious youth show differences in baseline PA, rate of return to baseline, and variability around baseline PA and tested whether these differences would depend on social context and anxiety subtype. Participants were 176 9- to 14-year-old youth, including 130 clinically anxious (with Social Anxiety Disorder, Generalized Anxiety Disorder, and/or Separation Anxiety Disorder) and 46 healthy youth. Youth reported their current PA, peak PA in the past hour, and social context in natural settings using ecological momentary assessment. Hierarchical linear models showed that both socially anxious and other anxious youth showed greater variability of PA relative to healthy youth. Youth with other anxiety disorders showed higher peak PA to a positive event relative to healthy youth. Feeling close to a friend was associated with higher peak PA, especially for socially anxious youth. Socially anxious youth showed significantly lower peak PA relative to both healthy and other anxious youth when interacting with a less close peer, but similar levels to these youth when interacting with a close friend. These findings suggest that clinically anxious youth may more sensitive to positive events and social interactions than healthy youth. Findings provide potential treatment targets for anxious youth, including applying regulatory strategies to positive events.

Clinically anxious youth consistently show increased negative affect and heightened neural response to threat (see Roy et al., 2008). Less research has evaluated how clinically anxious youth respond to positive and rewarding events (but see Anderson & Hope, 2008). Recently, researchers have theorized that some clinically anxious adolescents, particularly those with social anxiety, may experience lower levels of positive affect (PA) and enjoyment in response to positive stimuli relative to emotionally healthy youth (Caouette & Guyer, 2014; Silk, Davis, McMakin, Dahl, & Forbes, 2012). Given anxious youth's propensity to avoid highly threatening negative events (Kendall & Suveg, 2008), they may also attempt to avoid high-reward, high-risk positive events in order to prevent the possible feelings of evaluation, disappointment, and embarrassment that may accompany them. This anxious avoidance may also result in diminished PA, particularly high-arousal, exuberant expressions of PA such as happiness and excitement, in daily life because of missing out on the feelings of joy and belonging that can also arise from these types of experiences. During the transition to adolescence, a period in which highly positive social events and relationships (e.g., pursuing a high-status peer group) are becoming increasingly more salient and valued as well as riskier and uncertain (Blakemore & Mills, 2014; Nelson, Leibenluft, McClure, & Pine, 2005), anxious youth may find potential for threat in positive events as well (see Caouette & Guyer, 2014). Altogether, avoidance of potentially rewarding and positive social events may reduce the likelihood of actually experiencing PA as frequently or intensely as emotionally healthy peers, shaping their baseline mood or immediate response to events.

However, studies that have evaluated the possibility that anxious youth show diminished levels of PA have produced mixed findings. Whereas the tripartite model (Clark & Watson, 1991) theorized that clinically anxious individuals may show similar levels of PA compared to healthy individuals (and that differences lie in their higher negative affect), and some empirical findings have backed this theory (Chorpita, 2002; Lonigan, Hooe, David, & Kstner, 1999), other researchers have shown that anxious youth show diminished PA relative to healthy peers (Anderson & Hope, 2008; Anderson, Veed, Inderbitzen-Nolen, & Hansen, 2010; Chorpita, Plummer, & Moffitt, 2000; Henker, Whalen, Jamner, & Delfino, 2002), even after controlling for comorbid depressive symptoms.

This discrepancy in findings could be measurement-related, as many studies have utilized self-report measures of anxiety, rather than interview-based indices of anxiety (i.e., diagnostic interviews), and retrospective report of affect, rather than momentary reports of affect (see Anderson & Hope, 2008 for a review). Heterogeneity among youth with anxiety could also play a key role in mixed findings, with some subtypes of anxiety showing blunted PA more so than others. Specifically, a few studies have found that anxious youth with social anxiety, but not other anxiety disorders, report diminished PA as reported via questionnaire measures of affect (see Anderson & Hope, 2008). Adult research has also shown that adults with social phobia, but not other anxiety disorders, show low PA (Kashdan, Weeks, & Savostyanova, 2011).

These findings suggest that low PA in response to positive events could be specific to social anxiety disorder rather than to anxiety as a larger diagnostic category as a whole. Many positive events in adolescence are social in nature (Nelson et al., 2005) and the pursuit of these positive events may involve high levels of social evaluation. For example, trying out for a new team sport typically involves performing in front of coaches and peers and socializing with potential teammates. Socially anxious youth may also have worries about social pressures, both positive (e.g., receiving public accolades) and negative (e.g., "letting the team down" because of a loss), that accompany the team sport. These worries, especially those about positive evaluation or feedback, may not trigger youth with other anxiety disorders (e.g., those diagnosed with generalized anxiety disorder) as strongly (Weeks, Heimberg, Rodebaugh, & Norton, 2008). Thus, anxious youth, especially socially anxious youth, may differ in regard to positive affect in the context of events that occur in a social setting ("social context"), especially when with peers. Prior work examining PA and anxiety has primarily focused on PA in general using composite scores from self-report questionnaires (Chorpita, 2002; Chorpita et al., 2000; Lonigan et al., 1999), rather than delineating PA when with peers compared to mean levels of PA in general. Evaluating the social context of positive events may be important for clarifying the inconsistencies regarding anxiety group differences in PA.

One important aspect of social interactions is the degree to which one feels emotionally close to those with whom one is interacting. Emotional closeness is characterized by strong feelings of connection and support (Flores & Berenbaum, 2014). Prior work has demonstrated that socially anxious youth report feelings of anxiety in social settings, particularly when with others that they do not know well (Ollendick & Hirshfeld-Becker, 2002). Thus, degree of emotional closeness may be an important social contextual factor for the experience of positive emotions in social settings, particularly for youth with social anxiety disorder. Some work has demonstrated that emotional closeness serves as a social form of regulation, helping to ease stress and physiological arousal (Marroquin & Nolen-Hoeksema, 2015). Therefore, presence of a close peer (either in one-on-one interactions or as a buffer for large peer group interactions) may help socially anxious youth to relax and enjoy positive experiences more so than the presence of less connected peers.

Another potential reason for inconsistent findings for anxiety and differences in PA could be due to the dynamic nature of affect. One of the most significant characteristics of affect, including PA, is that it fluctuates over time and across situations (Kuppens, Oravecz, & Tuerlinckx, 2010). However, many studies evaluate emotion as static rather than as time-varying phenomena (e.g., Anderson & Hope, 2008; Chorpita, 2002). Kuppens and colleagues (2010) have proposed the DynAffect framework, which is based on dynamical systems models, to capture the key dynamic parameters associated with affective processes. For instance, individuals typically have a baseline emotional state—which is what is typically targeted in empirical studies of average emotion. Yet, in addition to baseline PA (termed "affective homebase" by Kuppens and colleagues), the more dynamic components of the model include how quickly changes in one's affect return to their baseline state ("attractor strength") and how much one's affect fluctuates across time ("affective variability"). In line with this, prior work has shown that greater variability in positive affect as well as negative affect is related to less psychological well-being (Houben, Van Den

Noortgate, & Kuppens, 2015), perhaps due to greater emotional instability. However, the relationship between affective variability and clinical anxiety in youth has not been explored. The DynAffect framework allows for testing of group differences in multiple components of affect (Kuppens et al., 2010). From this perspective, anxious youth may show differences in some elements of PA processes, such as PA variability, that mask differences in others (e.g., mean levels of PA).

One way to evaluate the nature of PA in clinically anxious adolescents is to use a design with high ecological validity that allows for repeated assessment of affect in natural contexts and that includes reporting of social context, such as level of closeness with a peer. The natural environment includes various activities, peer settings, and emotion-eliciting events (Silk, Steinberg, & Morris, 2003) that can expand upon findings obtained in more contrived laboratory settings. Intensive repeated assessment designs are also advantageous as they can be used to examine the dynamic nature of affect. Furthermore, assessment in the moment may reduce retrospective bias and help adjudicate among the inconsistent findings about childhood anxiety and PA. Thus far, one study has used ecological momentary assessment (EMA) to test differences in PA for youth with sub-threshold anxiety and found that higher anxiety symptoms were associated with lower mean levels of PA (Henker et al., 2002), but none have done so with a clinically anxious population.

Understanding how clinically anxious youth experience positive events is important because it can inform treatment. Given that positive emotions have been shown to promote wellness and recovery (Fredrickson, 2003), helping youth to more adaptively experience PA could be a useful intervention target. Furthermore, given that childhood anxiety is predictive of later psychopathology, including clinical depression and substance abuse (Bittner et al., 2007), knowing what characterizes childhood anxiety and how to effectively treat it could be helpful in preventing later serious mental illness.

The current study evaluated whether clinically anxious youth show diminished PA in their daily lives and tested whether these levels of PA depend on social context and anxiety subtype. We tested this question during the transition to adolescence (9- to 14-years), a period in which clinical levels of anxiety are becoming more prevalent (Kessler et al., 2005) and in which social relationships and events are becoming more salient and valued (Nelson et al., 2005). We focused on ratings of high-arousal positive affect (i.e., happiness), rather than more subdued, low level positive emotions (i.e., serenity, contentment), to align with prior research evaluating group differences in positive emotions (Anderson & Hope, 2008), and because of high-arousal PA's association with play, social interaction, and thought-action tendencies (Fredrickson, 2003). We hypothesized that anxious youth would report lower baseline levels of momentary PA and peak PA in response to a positive event relative to healthy youth, based on prior work with socially anxious adults (Kashdan et al., 2011). We also predicted that anxious youth would have more trouble holding onto their happy feelings (i.e., return to baseline faster) than healthy youth and explored differences in PA variability for anxious youth relative to healthy youth, based on recent work linking greater affective variability to psychiatric illness (Houben et al., 2015). Thus, we evaluated baseline, rate of return to baseline, and PA variability of both momentary PA and peak PA. We explored whether social context (interacting with a peer) would impact the proposed effects.

We also explored whether feeling close to a peer would attenuate the effect of anxiety on experience of PA, such that both healthy and anxious youth would experience more PA with a close friend than with a less close friend, but explored how the effect of a close friend on PA might differ for anxious youth. Finally, given evidence that social anxiety disorder may be associated with alterations in PA more than other anxiety disorders (Anderson & Hope, 2008), we evaluated these effects by subtype of anxiety, predicting that diminished PA findings would be specific to or stronger for socially anxious youth relative to other anxious youth.

Method

Participants

Participants included 176 9- to 14- year old youth, 130 clinically anxious and 46 emotionally healthy, participating in a larger clinical trial (NCT00774150 PI:Ryan; Silk et al., in press). Clinically anxious youth were eligible if they met criteria for a DSM-IV diagnosis of generalized anxiety disorder (n=94), separation anxiety disorder (n=34), and/or social phobia (n=28). Of the anxious youth that were eligible, 40 met criteria for multiple anxiety disorders and 19 had other comorbid disorders including Major Depressive Disorder (n=1), Attention Deficit Hyperactivity Disorder, Inattentive Only Subtype (n=5), Enuresis (n=4), Tic Disorders (n=6), and Oppositional Defiant Disorder (n=3). To evaluate effect of social anxiety specifically, we created two groups of anxious youth—those who met criteria for social anxiety disorder (n=28; 15 with other comorbid anxiety disorders, see Table 1) and those who met criteria for other anxiety disorders, but not social anxiety disorder ("youth with other anxiety disorders", n=102).

There were no significant differences in gender, family income, or parental education level between the anxious and healthy groups (Table 1). Youth with other anxiety disorders were significantly younger than both the socially anxious youth and the healthy youth, $F(2, 173)$ =4.07, p<.02, $M_{OtherAnxious}$=10.79; $M_{SocialAnxiety}$=11.48, $M_{Healthy}$=11.39, thus child age was included as a covariate in the final models. There were a higher percentage of Caucasian participants in the anxious group compared to the healthy group, 90% Anxious, 57% Healthy, χ^2=17.91, df=8 p<.03. However, as there were no significant differences between Caucasian and Non-Caucasian participants on PA reported from the EMA calls $M_{Caucasian}$=2.75, $M_{Non-Caucasian}$=2.57; t=1.07, df=174, p=.29, we did not include race as a covariate in analyses. Youth from this study were recruited through community advertisements, psychiatric clinics, and other research studies. All provided assent, their parents provided informed consent, and the university IRB approved the protocol.

Exclusion criteria included an IQ below 70 as assessed by the Wechsler Abbreviated Scale of Intelligence (Wechsler, 1999), ongoing treatment with psychoactive medications, acute suicidality or risk for harm to self or others, pregnancy, presence of metal braces or metal objects in their body or other MRI contraindications (for the larger clinical trial). Specific exclusion criteria for anxious participants included a current primary diagnosis of major depressive disorder (MDD), a current diagnosis of obsessive-compulsive disorder (OCD), post-traumatic stress disorder (PTSD), conduct disorder, substance abuse or dependence, and ADHD combined type or predominantly hyperactive-impulsive type. Anxious youth were

also excluded if they had a lifetime diagnosis of Autism spectrum disorder, bipolar disorder, psychotic depression, schizophrenia, or schizoaffective disorder. If youth had previously completed a course of cognitive behavioral therapy they were also excluded. Exclusion criteria for healthy controls also included symptoms suggestive of an Axis I psychiatric disorder on the Schedule for Affective Disorders and Schizophrenia in School-Age Children-Present and Lifetime version (K-SADS-PL, Kaufman et al., 1997)

Procedures

Anxious youth that were eligible were randomized to weekly cognitive behavioral therapy (CBT; n=87; n=18 Socially Anxious youth) or child-centered supportive therapy (CCT; n=43; n=10 Socially Anxious youth) as part of the larger 16-session clinical trial. There was no significant difference in the proportion of socially anxious youth in CBT vs. CCT, χ^2=. 11, df=1, p=.82. Although the majority of anxious youth showed improvements in anxiety severity (i.e., 35% reduction in symptoms on the Pediatric Anxiety Rating scale) after treatment, 71.1% in CBT, 55.8% in CCT; β=.56, df=112, p=.18 (Silk et al., in press), there was no change in momentary PA across the treatment period (see Table 2). Peak PA decreased across the treatment period (see Table 2 and 3), so time was included as a covariate in our models to control for any potential effects. Furthermore, there were no differences in change in PA for clinically anxious youth who completed CBT or CCT, β=.08, t=1.19, df=121, p=.23, so the treatment groups were combined into one anxious group for this study and PA was evaluated across the 16-session period to increase power to detect effects.

Measures

Psychiatric history—To determine the youths' psychiatric history, the KSADS was used. Independent evaluators interviewed the parent and child separately. Interviewers integrated information from both child and parent to reach a final diagnosis. The interview results were presented at a consensus case conference with a child psychiatrist, who reviewed the preliminary diagnosis and provided a final diagnosis based on DSM-IV criteria. Inter-rater reliability was computed on 16% of the diagnostic interviews and reliability for anxiety diagnoses was good (Kappa=.97).

Depressive symptoms—To determine severity of youth depressive symptoms, youth and their parents completed the Mood and Feelings Questionnaire (MFQ; Angold & Costello, 1987) at the beginning of the study. Items on the MFQ are rated on a 3-point Likert scale (0=*not true*, 2= *true*). The child version of the MFQ has 33 items and the parent version has 34 items. A sample item from the MFQ includes "I cried a lot". The MFQ had strong reliability in our study (αs=.93 for both child and parent report). Child and parent report were significantly correlated (r=.46, p<.01) and thus scores for both were centered and averaged for use as a covariate in hierarchical linear models.

Ecological Momentary Assessment—A cellular phone methodology was used to collect EMA data on youths' real-world emotions and social context (Silk et al. 2011). Youth were given answer-only cellular phones on which trained interviewers conducted EMA interviews. The youth underwent an orientation session in which they were familiarized with

the phone and interview questions. Anxious youth received the calls in five 5-day blocks starting Thursday night and ending Monday night prior to treatment session 1, and after sessions 4, 8, 12, and 16 (mean data collection period = 18.36 weeks, *SD*=3.27 weeks). Two calls were made each weeknight- on Thursday, Friday and Monday- and four calls were made on Saturday and on Sunday totaling 14 calls per EMA week. Calls were placed within a given window (e.g., 4–8pm on a weeknight) but not at a pre-specified time so that participants were not expecting them. Healthy youth did not receive the 16-session weekly treatment or additional attention, but received calls along the same schedule.

Each call consisted of a brief structured interview adapted from Silk et al. (2003; 2011). Trained bachelor's level interviewers conducted all calls for the study. Interviewers were not randomized to participants, due to scheduling complexities, but there were no outliers for child PA ratings per interviewer. The interview was approximately 5 minutes long, and included assessments of youths' current and peak PA over the past hour, current social context and closeness/connectedness with interaction partners. The youth were asked to rate their current emotion from a list of items on a 5 point scale ranging from (1) *very slightly or not at all* to (5) *extremely*. The current study focused on youths' ratings of happy affect at the moment before the call (Momentary PA). The youth were also asked to identify and describe their most positive event in the past hour (e.g., "watching a movie", "a friend came over") and rate how happy they were during this event in the past hour on the same 5-point scale (Peak PA). Youth's most positive event was later categorized into type (i.e., sports/ leisure, family, tv/media). All three groups had the same 5 types of positive events as their most frequent (see Table 1). Previous research has shown that a window of one hour maximizes the chances of assessing naturally occurring emotional experiences while minimizing biases of retrospective recall (Silk et al., 2003). We chose to focus on happy affect, but not other positive emotion ratings (e.g., cheerful) because ratings of peak PA only included happy affect. Momentary ratings of happy affect were highly correlated with momentary ratings of cheerful, excited, and interested affect (rs=.62–.83, p<.01).

After assessing momentary PA, youth were asked who they were interacting with—whether in person, on the telephone, or on the computer—in order to examine social context. Similarly, after reporting their peak PA, youth were asked to report who they were interacting with at the time of the most positive event. If interacting with a peer (friend, classmate, romantic interest/partner), youth were prompted to rate how close they felt to that person on the same five-point scale. If youth were interacting with more than one peer, the closeness ratings for each peer were averaged for that call. For all calls, youth were encouraged to move to a private area to complete the call and interviewers recorded youth's responses verbatim using pen and paper at the time of the call. Interviewers noted any concerns about the validity of participant data on their response sheet. For all calls in the current study, interviewers reported that participants appeared to understand the questions and answer them honestly

Data analytic plan

Similar to Ebner-Priemer et al. (2015), we used Kuppens' DynAffect framework in HLM7 to test group differences in baseline PA, return to baseline PA, and PA variability for both

momentary PA and peak PA. In the DynAffect framework, a two-level HLM model of time-points (level 1) nested within participants (level 2) is used to model the dynamical system. Specifically, individual differences in baseline PA are captured by the random intercept, rate of return to baseline is estimated as a random autoregressive effect (i.e., PA at time=t regressed on PA at t-1; i.e.,"lag PA"), and PA variability is estimated as the level 1 residuals (i.e., shifts observed in affect between assessments after controlling for PA at last assessment). Momentary PA and peak PA were modeled separately (each as dependent variables). Study group (i.e., anxiety sub-type: social anxiety, other anxiety, and healthy controls) was entered as a level 2 predictor of individual differences in each of these parameters.

Level 1 equation:

$$PA_{ti} = \pi_{0i} + \pi_{1i} * PA_{(t-1)i} + e_{ti}$$

Level 2 equation:

$$\pi_{0i} = \beta_{00} + \beta_{01} * (Social\ Anxiety) + \beta_{02} * (Other\ Anxiety) + r_{0i}.$$
$$\pi_{1i} = \beta_{10} + \beta_{11} * (Social\ Anxiety) + \beta_{12} * (Other\ Anxiety) + r_{1i}.$$
$$Var\,(R) = \sigma^2 \; and \log(\sigma^2) = \alpha_0 + \alpha_1\,(Social\ Anxiety) + \alpha_2\,(Other\ Anxiety).$$

Furthermore, we evaluated the effect of social context on these PA variables by limiting models to include only calls when with peers and running models for those constrained calls. Then, we tested whether degree of closeness moderated group differences in PA (i.e., a cross-level interaction effect).

We first ran models with current (momentary) PA at time of the call serving as the outcome. We then ran models evaluating these effects on peak PA in response to a positive event in the past hour. For all models, the random autoregressive effect was not included for first call of the day, given that t-1 would reflect the call from the previous night. For calls with peers, the random autoregressive effect was computed as PA at t-1 regardless of whether the participant was with a peer for the call at t-1.

Models in which we evaluated the moderating effect of closeness were constrained to calls in which youth were interacting with the same person at the time of the call and at the time of the peak positive event (73% of calls). There was no group difference in the number of matched calls completed (F(2, 173) =1.99, p=.14, $M_{Healthy}$=32.20, $M_{OtherAnxiety}$=32.25, $M_{SocialAnxiety}$=37.04).

Level 1 equation:

$$PA_{ti} = \pi_{0i} + \pi_{1i} * PA_{(t-1)i} + \pi_{2i} * (Closeness) + e_{ti}$$

Level 2 equation:

$$\pi_{0i} = \beta_{00} + \beta_{01} * (Social\ Anxiety) + \beta_{02} * (Other\ Anxiety) + r_{0i}.$$
$$\pi_{1i} = \beta_{10} + \beta_{11} * (Social\ Anxiety) + \beta_{12} * (Other\ Anxiety) + r_{1i}.$$
$$\pi_{2i} = \beta_{20} + \beta_{21} * (Social\ Anxiety) + \beta_{22} * (Other\ Anxiety) + r_{1i}.$$

Mixed Model:

$$PA_{ti} = \beta_{00} + \beta_{01} * (Social\ Anxiety) + \beta_{02} * (Other\ Anxiety) + \beta_{10} * PA_{(t-1)i} +$$
$$\beta_{11} * PA_{(t-1)i} * (Social\ Anxiety) + \beta_{12} * PA_{(t-1)i} * (Other\ Anxiety) + \beta_{20} * Closenses +$$
$$\beta_{21} * Closeness * (Social\ Anxiety) + \beta_{22} * Closeness * (Other\ Anxiety)$$
$$Var\ (R) = \sigma^2\ and log\ (\sigma^2) = \alpha_0 + \alpha_1\ (Social\ Anxiety) + \alpha_2\ (Other\ Anxiety).$$

As girls and younger children reported higher current and peak PA in this sample, $F(1, 174)$ s=4.44–9.11, ps<.04 for gender and PA; rs= −.16 to−.19, ps<.04 for age and PA), child age and sex were included as covariates in each of the models. Also, because depressive symptoms are often comorbid with anxiety and are strongly associated with low PA (Anderson & Hope, 2008), we included child depressive symptoms (average of child-reported and parent-reported symptoms) as a covariate in all models to confirm that group differences on PA remained after accounting for the effect of child depressive symptoms. We also included call number (centered) as a covariate in the models to control for any potential time effects (i.e., change in PA across the 16-session period, "time"). For all models, significant interactions were explored using simple slopes analyses in which values for high and low emotional closeness were computed by subtracting or adding one standard deviation from the within-participant centered closeness score. Regression models using the high or low closeness score were then conducted to explore the interactive effect of closeness and anxiety sub-type on positive affect (Preacher, Curran, & Bauer, 2006)

Results

There were no group differences in EMA compliance, with socially anxious youth completing 57.07/70 possible calls (82%), other anxious youth completing 53.71/70 possible calls (77%), and healthy youth completing 54.26/70 (78%) possible calls, $F(2, 173)$ =.48, p=.62. Compliance rates were comparable to those reported in other EMA studies (Larson, Moneta, Richards, & Wilson, 2002; Silk et al., 2003). Groups also reported being with peers for comparable numbers of calls (Table 1). There was no difference in emotional closeness for healthy youth, socially anxious youth, and youth with other anxiety disorders, $F(2, 173)$ =.35, p=.71. Fit indices improved with inclusion of our predictors, i.e., anxiety groups, emotional closeness for both models of momentary PA and peak PA (deviance = 16,467.07 for momentary PA unconditional model, deviance=1,358.77 to 16,198.66 for conditional models with predictors; deviance = 12,034.07 for peak unconditional model, deviance = 1,139.61 to 11,879.19 for conditional models with predictors).

Anxiety and Momentary PA

There were no group differences for baseline momentary PA or return to baseline momentary PA (ps=.66–.80) (Table 2). However, there was a significant group difference for

affective variability, such that both socially anxious and other anxious youth showed greater variability in momentary PA relative to healthy youth (β=0.15, z=2.53, p<.02; β=0.50, z=11.38, p<.01, respectively) and other anxious youth showed greater variability in momentary PA relative to socially anxious youth (β=−0.35, z=−6.82, p<.01). Figure 1 illustrates that the direction of this association may be that youth with other anxiety disorders experience higher highs in PA whereas socially anxious youth experience lower lows in PA relative to healthy youth.

Anxiety and Peak PA

There were no group differences in baseline peak PA or return to baseline peak PA (ps=.52–.95). However, youth with other anxiety disorders showed greater variability in peak PA relative to healthy youth (β=−0.10, z=−2.10, p<.04) and relative to socially anxious youth (β = −0.14, z=−2.49, p<.02). There was no difference between socially anxious and healthy youth for variability in peak PA (p=.52).

Peer Context and Emotional Closeness and Momentary PA

For models in which we limited calls to those when with peers, there were no group differences in baseline momentary PA or return to baseline momentary PA (ps=.65–.69) (Table 2). However, both other anxious youth and socially anxious youth showed greater variability in momentary PA relative to healthy youth when with peers (β=1.05, z=7.20, p<.01; β=0.54, z=2.36, p<.02). Also, other anxious youth showed greater variability in momentary PA relative to socially anxious youth when with peers (β= −0.51, z=−2.42, p<.02). There were no main or interactive effects of emotional closeness when with peers on momentary PA (ps=.21–.66).

Peer Context and Emotional Closeness and Peak PA

For peak PA when with peers, other anxious youth showed higher peak PA in response to a positive event when with a peer relative to healthy youth (β=1.04, t=2.35, df=122, p<.03), but not relative to socially anxious youth (p=.87). There was no difference between socially anxious and healthy youth for peak PA (p=.14). Also, models in which we examined the effect of emotional closeness showed that there was an interactive effect of emotional closeness and anxiety sub-type on peak PA such that feeling close to a peer was associated with higher peak PA to a positive event more so for socially anxious youth relative to healthy youth (β=0.38, t=2.48, df=125, p<.02) (Table 3). Youth with other anxiety disorders did not differ from healthy youth (p=.21) or socially anxious youth (p=.13) for this effect. Simple slope analyses revealed that when interacting with a less close peer (1 SD below within-person mean), socially anxious youth reported significantly lower peak PA relative to both healthy youth (β= −0.49, t=−3.28, df=125, p<.01) and other anxious youth (β= −0.28, t= −2.41, df=125, p<.02). There was no difference between youth with other anxiety disorders and healthy youth for peak PA when interacting with a less close peer (p=.11). When interacting with a highly close peer (1SD above within-person mean), there were no group differences in peak PA (ps=.20–.90). (Figure 2).

Discussion

Our study demonstrated that the ways in which anxious youth experienced PA and responded to positive events depended on anxiety subtype and social context. First, both socially anxious youth and other anxious youth showed *greater* variability in momentary PA. In line with this, youth with other anxiety disorders also reported *higher* peak levels of PA in response to a positive event relative to healthy youth and showed greater variability in peak PA relative to both socially anxious youth and healthy youth. Combined, these findings suggest that youth with GAD and separation anxiety may be highly reactive to positive events and may experience higher highs in regard to PA than both healthy youth and socially anxious youth. Prior neurobiological work has shown that anxious youth appear to be hypervigilant and reactive to contingent positive stimuli, similar to contingent negative stimuli, (Caouette & Guyer, 2014) and this tendency may explain our reactivity findings. In this case, anxious youth may care a lot about their performance and place greater value on feedback about their performance, even when the feedback is positive.

Our findings also suggest that anxious youth, specifically socially anxious youth, may be more sensitive to social context in regard to PA. Feeling close to a peer was associated with greater peak PA in response to a positive event for socially anxious youth (but not for other anxious youth) more so than for healthy youth. In fact, when interacting with a less close peer, socially anxious youth showed significantly lower peak PA to a positive event relative to healthy youth and other anxious youth. However, when interacting with a peer to whom they felt especially close, socially anxious youth showed similar levels of peak PA relative to both groups of youth. A close friend may serve a regulatory role for these youth, helping them feel more at ease in social settings. The increasingly peer-oriented context of PA during adolescence may heighten vulnerability for socially anxious youth during this period in social contexts without appropriate regulatory solutions. Indeed, although socially anxious youth reported comparable *mean* levels of momentary and peak PA relative to other youth when collapsing across contexts, we found indicators that socially anxious youth may have diminished enjoyment of positive events in some contexts (i.e., when interacting with a peer with whom they did not feel close or know well). Commensurate with this, they seem to experience lower lows when it comes to momentary PA relative other youth, perhaps further suggesting risk for anhedonia, however more research that can empirically assess the direction of variability is needed to confirm this.

There are many reasons why socially anxious youth may show these disruptions in PA. First, these youth may be more likely to miss out on fun and social activities that tend to elicit PA in youth, such as attending parties and making new friends, relative to healthy peers. These events are likely to be experienced as stressful for most adolescents, but healthy youth likely also find them to be rewarding and fun (Blakemore & Mills, 2014). For socially anxious youth, because many socially rewarding experiences during the transition to adolescence are also risky, in that they involve the possibility of disappointment and rejection, these experiences may elicit feelings of threat and evaluation in socially anxious youth (Caouette & Guyer, 2014; Silk et al., 2012). Furthermore, some work suggests that individuals with higher levels of social anxiety find positive, social events especially stressful because of a fear of positive evaluation (similar to fear of negative evaluation; Weeks et al., 2008),

creating the high likelihood for feelings of discomfort (either from disappointment/rejection or positive evaluation) to arise from social events. Fear of positive evaluation may be related to general discomfort during evaluative situations (even if the evaluative content is positive) or from placing an inordinately high value on positive evaluations of others. Accordingly, anxious youth, particularly socially anxious youth, may not only fail to seek out these experiences but also actively avoid them when presented with the opportunity for them, given their tendency to avoid highly threatening and/or novel situations (Kendall & Suveg, 2008). Ultimately, the combination of this heightened value of positive experiences and anxious avoidance of social experiences and events may contribute to a maladaptive cycle that ultimately places them at risk for persistent anxiety and even later depression (Silk et al., 2012).

It is possible that stable temperamental differences, such as behavioral inhibition, could drive how socially anxious youth experience PA. In this case, socially anxious youth may have experienced lower levels of approach behavior and PA relative to their peers throughout development, even prior to the onset of social anxiety. Since peer relationships/events begin to dominate the scene during the transition to adolescence (Nelson et al., 2005), these temperamental preferences to avoid social events may widen the gap between these inhibited youth and their peers during adolescence and could contribute to the propensity to develop social anxiety disorder (rather than being a consequence of the disorder). Nevertheless, whether these affective differences were a stable characteristic of an inhibited temperament or arose with social anxiety disorder, altered PA in these youth may contribute to persisting anxiety and place them at greater risk for other disorders (e.g., depression, substance abuse) in the future.

Youth with other anxiety disorders also showed an altered profile for positive affect. In this case, these youth reported *higher* levels of peak positive affect overall and with peers, and *greater* affective variability than other youth across contexts. Greater variability in positive affect has been associated with lower levels of psychological well-being in prior work (Houben et al. 2015), perhaps because more variability in affect, even PA, may reflect greater emotional instability. Combined, these findings suggest that youth with other anxiety disorders may experience higher highs than healthy and socially anxious youth. In keeping with prior work showing greater neurobiological sensitivity (i.e., heightened striatal responding when anticipating positive feedback; Caouette & Guyer, 2014), youth with other anxiety disorders may place greater value and salience on positive outcomes and experiences, and similar to their heightened experience of negative emotions, may feel positive emotions in response to positive events more intensely.

Our study has several strengths. It is one of the first to evaluate differences in PA in clinically anxious youth using an EMA paradigm. We conducted a nuanced evaluation, taking into consideration (1) anxiety sub-type, (2) social context, and (3) multiple aspects of PA dynamics (i.e., peak, variability, return to baseline). In doing so, we now provide new ecologically valid evidence that although overall, youth anxiety is not associated with diminished mean levels of PA, some anxious youth (i.e., those with social anxiety disorder) show disruptions in PA (greater variability that reflect lower lows in PA and peak PA that is sensitive to level of closeness with peers) that may be masked by averaging PA levels across

time, context, and anxiety sub-type. Indeed, our findings may explain inconsistencies in prior work regarding clinical anxiety and PA and provide greater specificity to extant literature. We note however that our socially anxious youth reported comparable levels of positive affect in some contexts, including comparable levels of momentary positive affect and comparable levels of peak positive affect when with a close peer, helpful findings that could be harnessed in treatment (i.e., aiding socially anxious youth to hold on to their happy feelings and helping them to foster close relationships).

There were also some limitations to our study. We did not evaluate negative affect for the current report given that prior work with this sample has already demonstrated that, consistent with the extant literature of NA and anxiety in youth, anxious youth showed higher levels of peak negative affect in response to stressful events relative to healthy youth (Tan et al., 2012). Instead, for the current report, we chose to focus on PA given discrepancies about anxiety and PA in the literature. The anxious youth in our study were participating in a larger clinical trial in which a portion of the exposure-based treatment (CBT) was geared at improving social functioning (Silk et al., in press). Although findings suggest that anxious youth did not change on PA across treatment, it is possible that the youth in our study may have differed from anxious youth not receiving treatment. Also, although our socially anxious group was relatively small, our focus was primarily on the within-person effects and their moderation by group, which benefited from the large number of level 1 observations (i.e., approximately 55 per participant). Also, approximately half of our socially anxious participants met clinical criteria for other anxiety disorders (GAD, Specific Phobia). Although our methods still allowed us to isolate anxious youth with clinically significant social anxiety symptoms from anxious youth without these symptoms, future work should evaluate these questions in a larger sample of socially anxious youth without other comorbidities. Also, in regard to generalizability, the majority of our sample was White/Caucasian. Varying cultural beliefs may contribute to experiencing PA in unique ways. Our EMA protocol utilized calls, rather than text messages, which could have been anxiogenic, especially for socially anxious youth. However, use of calls has been an effective and widely-used method of experience sampling in past studies (Silk et al., 2003, Silk et al., 2011), and further, socially anxious youth in the current study completed comparable numbers of calls relative to both other anxious and healthy youth—suggesting they did not find the calls to be overly anxiety-producing. Peak PA was measured retrospectively (highest level of PA during the most positive event in the past hour) in the current study, thus it may be that retrospective bias influenced our findings for peak PA. Lastly, PA and peer interactions were assessed after school and during weekends whereas peer interactions may be especially emotionally salient during school hours. On the other hand, assessing peer interactions during times youth chose to be with peers outside the convenience of school hours may provide a useful examination of variables like PA and closeness. Future work should also evaluate the role of family context on PA in youth.

Our findings have potential implications for prevention and intervention. Evidence suggests that anxious youth are at elevated risk for developing depression during adolescence and adulthood (Bittner et al., 2007) and one putative mechanism for this risk may be differences in experiencing PA (Silk et al. 2012). Given that adolescence involves many social developmental changes, such as spending more time with peers, understanding ways in

which to help anxious youth thrive when with peers is important. Our findings could provide concrete ways in which interventions geared at anxious youth can serve a preventive and interventive role, such as utilizing exposures geared at seeking out and enjoying positive events, applying regulatory strategies typically employed to manage negative affect, and helping socially anxious youth to enjoy interactions with peers. Specifically, treatment approaches could include helping socially anxious youth to (1) increase their attention to positive stimuli via attention bias modification training (ABMT; Waters, Pittaway, Mogg, Bradley, & Pine, 2013), (2) identify positive outcomes of potentially positive, albeit risky events via cognitive restructuring (3) engage in behavioral activation strategies to foster positive events in daily life (Bilek & Ehrenreich-May, 2012), and (4) savor positive affect when it does occur (McMakin, Siegle, & Shirk, 2011). Additionally, helping socially anxious youth to foster close friendships early in development might help boost their experiences of positive affect, especially during the transition to adolescence. Furthermore, these effective treatment modules that directly address PA and socially rewarding relationships may prevent or attenuate the trajectory from child anxiety to future psychopathologies such as depression.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Appendix

Ecological Momentary Assessment Questions

I am going to ask you some questions about how you were feeling when the phone rang.

How would you rate how happy (good, satisfied) you were?

1= very slightly or not at all

2=a little

3=moderately

4=quite a bit

5=extremely

At the moment the phone rang, what were you doing? _____

Who were you interacting with (in person, on telephone, on computer) when the phone rang? _____

How close or connected did you feel to (restate person they were interacting with) right now?

1= very slightly or not at all

2=a little

3=moderately

4=quite a bit

5=extremely

Think about the most enjoyable or happy time in the past hour. What happened?

Was anyone with you? Yes No

If Yes, who was with you? _____

When was it?

1= right before I was called

2=about 15 minutes ago

3=about 30 minutes ago

4=about 45 minutes ago

5=about an hour ago
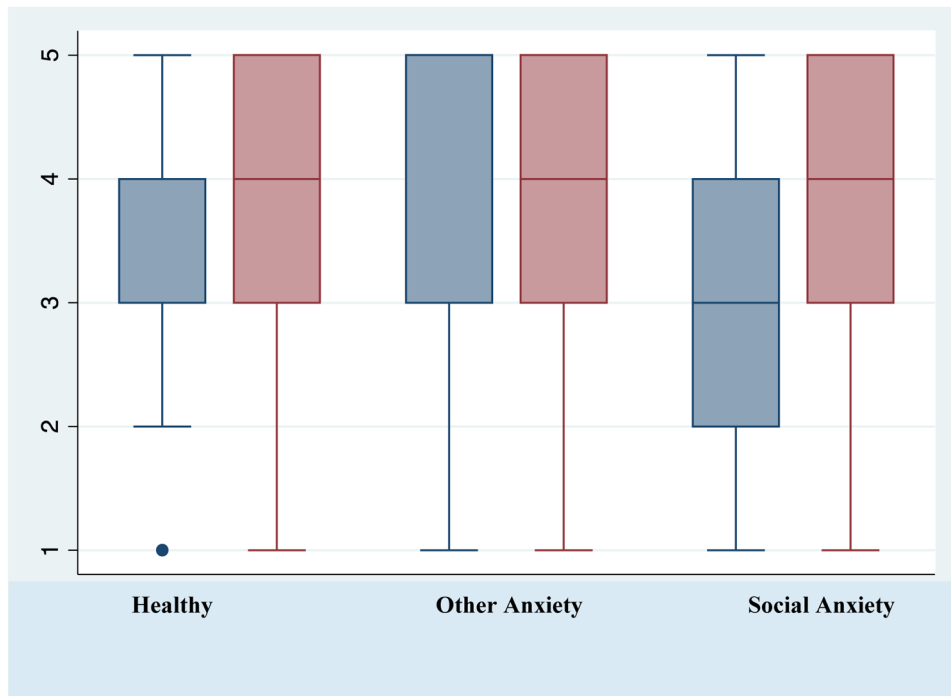
At the best point, how happy did you feel?

1= very slightly or not at all

2=a little

3=moderately

4=quite a bit

5=extremely

Positive Affect

Figure 1.
Variability of Momentary (left, blue) and Peak (right, red) Positive Affect and Anxiety Subtype.
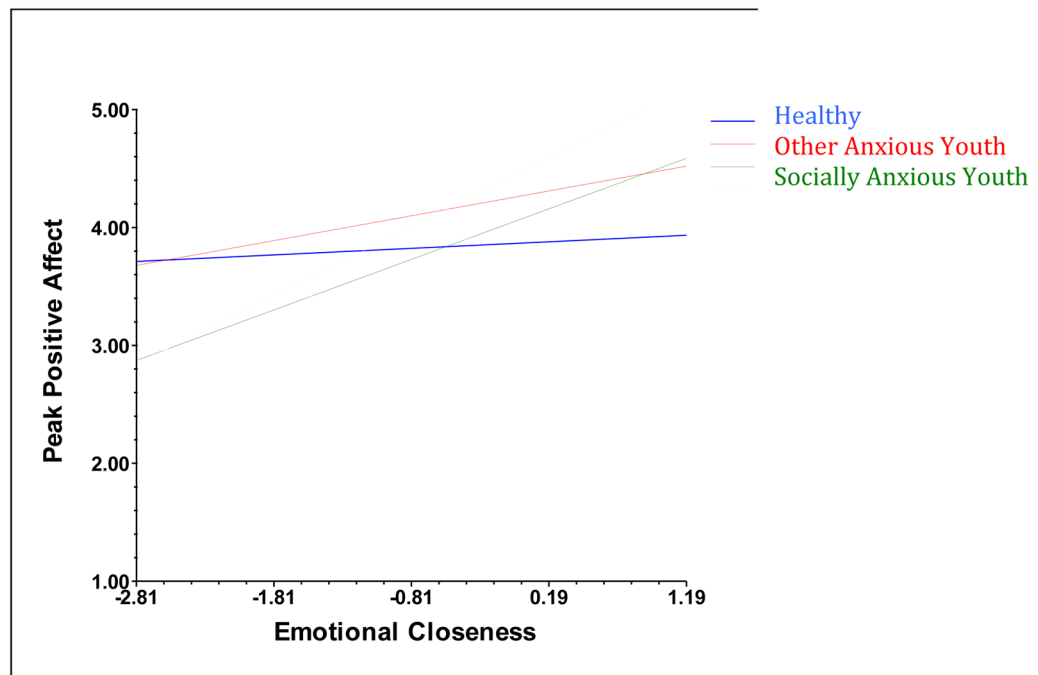
Figure 2.
Emotional Closeness on Peak Positive Affect by Group.
Note. Values for emotional closeness have been mean-centered.

Table 1

Sample Characteristics by Group

Variable	Healthy Youth (n=46)	Other Anxious Youth (n=102)	Socially Anxious Youth (n=28)	F/χ^2
Age	11.39 (1.66)	10.76 (1.40)	11.48 (1.51)	F=3.87*
Gender	57% Female	52% Female	64% Female	χ^2=1.27
Depressive Symptoms	2.82 (3.17)	17.23 (8.38)	15.36 (8.42)	F=52.39**
Completed Calls (all)	54.26/70 (78%)	53.71/70 (77%)	57.07/70 (82%)	F=.48
Completed Calls (peer)	6.65/70 (9.5%)	5.40/70 (7.7%)	4.71/70 (6.7%)	F=1.16
Mean Momentary PA	3.36 (.92)	3.43 (.84)	3.23 (.89)	F=.55
Mean Peak PA	3.79 (.73)	4.04 (.70)	3.83 (.69)	F=2.45
Mean Closeness	3.76 (.73)	3.87 (.79)	3.79 (.71)	F=.35
Clinical Characteristics	n/a	GAD only(47) SAD only(19) GAD and SAD(8) GAD and Other(23) SAD and Other(5)	Social only(12) Social and GAD(13) Social and SAD(1) Social, GAD, SAD(1) Social and Other(1)	--
Type of Positive Event (% Calls for Top 5 Listed per Group)	TV/media 16%, Sports/Leisure 14%, Food 14%, Family 11%, Peer 11%	Sports/Leisure 17%, TV/media 16%, Family 13%, Peer 11%, Food 10%	TV/media 16%, Family 13%, Food 12%, Sports/Leisure 14%, Peer 8%	--

**
p<.01;

*
p<.05. PA= Positive Affect. Social= Social Anxiety Disorder. GAD= Generalized Anxiety Disorder. SAD=Separation Anxiety Disorder.

Table 2

Anxiety Sub-Type on Momentary and Peak PA

Fixed	Momentary PA (all calls)					Fixed	Peak PA (all calls)					Fixed	Momentary PA (Peers)					Fixed	Peak PA (Peers)				
	Coeff	SE	t	d.f.	p		Coeff	SE	t	d.f.	p		Coeff	SE	t	d.f.	p		Coeff	SE	t	d.f.	p
Intercept						**Intercept**						**Intercept**						**Intercept**					
Intercept	3.05	.38	7.94	170	<.001	Intercept	3.71	.36	10.39	170	<.001	Intercept	1.92	.61	3.14	132	.01	Intercept	1.88	.43	4.40	128	.001
Dep Sx	-.01	.01	-2.23	170	.03	Dep Sx	-.01	.01	-1.42	170	.16	Dep Sx	-.01	.01	-1.40	132	.17	Dep Sx	-.01	.00	-1.54	128	.12
Age	-.06	.03	-1.89	170	.06	Age	-.06	.03	-2.20	170	.03	Age	.03	.05	.56	132	.58	Age	-.03	.03	-1.01	128	.32
Sex	.17	.10	1.67	170	.10	Sex	.25	.08	2.90	170	.00	Sex	.18	.13	1.34	132	.18	Sex	.24	.08	2.87	128	.01
Soc Anx	.07	.27	.25	170	.80	Soc Anx	-.18	.28	-.65	170	.52	Soc Anx	.23	.57	.40	132	.69	Soc Anx	.94	.64	1.47	128	.14
Other Anx	.10	.22	.44	170	.66	Other Anx	.01	.21	.07	170	.95	Other Anx	-.19	.41	-.46	132	.65	Other Anx	1.04	.14	2.35	128	.02
Lag PA						**Lag PA**						**Lag PA**						**Lag PA**					
Intercept	.20	.04	4.50	173	<.001	Intercept	.11	.03	3.51	173	<.001	Intercept	.31	.08	3.90	135	.001	Intercept	.51	.08	5.99	131	.001
Soc Anx	.02	.06	.36	173	.72	Soc Anx	.09	.05	1.61	173	.11	Soc Anx	-.05	.15	-.31	135	.76	Soc Anx	-.18	.14	1.33	131	.11
Other Anx	.05	.05	1.06	173	.29	Other Anx	.07	.04	1.81	173	.07	Other Anx	.08	.10	.80	135	.42	Other Anx	-.17	.10	-1.71	131	.07
Time						**Time**						**Time**						**Time**					
Intercept	-.00	.00	-.52	175	.60	Intercept	-.00	.00	-4.95	175	<.001	Intercept	-.00	.00	-1.41	137	.16	Intercept	-.00	.00	-2.42	133	.02

Note. PA= Positive Affect. Fixed=Fixed Effect. Coeff=Coefficient. Dep Sx= Depressive Symptoms. Soc Anx=Social Anxiety. Other Anx=Other Anxiety. Lag PA = PA at t-1 Time =Call Number.

Table 3

Anxiety Sub-Type and Emotional Closeness on Momentary and Peak PA with Peers

	Momentary PA (Peers)						Peak PA (Peers)				
Fixed	*Coeff*	*SE*	*t*	*d.f.*	*p*	*Fixed*	*Coeff*	*SE*	*t*	*d.f.*	*p*
Intercept						**Intercept**					
Intercept	1.96	.60	3.26	132	.001	Intercept	1.96	.48	4.10	122	.001
Dep Sx	−.01	.01	−1.52	132	.13	Dep Sx	−.01	.01	−.89	122	.38
Age	.02	.05	.51	132	.61	Age	−.03	.03	−.95	122	.34
Sex	.19	.13	1.41	132	.16	Sex	.21	.10	2.19	122	.03
Soc Anx	.26	.54	.49	132	.63	Soc Anx	.61	.76	.80	122	.42
Other Anx	−.14	.40	−.35	132	.72	Other Anx	1.20	.47	2.53	122	.01
Lag PA						**Lag PA**					
Intercept	.32	.08	4.18	135	.001	Intercept	.50	.10	5.11	125	.001
Soc Anx	−.06	.14	−.42	135	.76	Soc Anx	−.11	.16	−.67	125	.51
Other Anx	.07	.10	.67	135	.42	Other Anx	−.21	.11	−1.89	125	.06
Time						**Time**					
Intercept	−.00	.00	−1.20	137	.23	Intercept	−.00	.00	−2.40	127	.02
Closeness						**Closeness**					
Intercept	.10	.11	.87	135	.39	Intercept	.03	.11	.26	125	.80
Soc Anx	.26	.24	1.11	135	.27	Soc Anx	.38	.15	2.48	125	.01
Other Anx	−.10	.15	−.62	135	.54	Other Anx	.18	.14	1.26	125	.21

Note. PA= Positive Affect. Fixed=Fixed Effect. Coeff=Coefficient. Dep Sx= Depressive Symptoms. Soc Anx=Social Anxiety. Other Anx=Other Anxiety. Lag PA = PA at t-1. Time =Call Number.