How is affective instability defined and measured? A systematic review

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Acknowledgements

This work was, in part, funded by a grant from the Mental Health Research Network (MHRN) UK, Heart of England Hub.

Abstract

Background: Affective instability (AI) is poorly defined but considered clinically important. This study aimed to examine definitions and measures of AI employed in clinical populations.

Method: A systematic review using the PRISMA guidelines. MEDLINE, EMBASE, PsycINFO, PsychArticles and Web of Science databases were searched. Five journals were hand searched. Primary empirical studies involving randomized controlled trials (RCTs), non-RCTs, controlled before and after, and observational investigations were included. Studies were selected, data extracted and quality appraised. A narrative synthesis was completed.

Results: 11443 abstracts were screened and 37 studies selected for final analysis on the basis they provided a definition and measure of AI. Numbers of definitions for each of the terms employed in included studies were: affective instability (N=7), affective lability (N=6), affective dysregulation (N=1), emotional dysregulation (N=4), emotion regulation (N=2), emotional lability (N=1), mood instability (N=2), mood lability (N=1) and mood swings (N=1); but these concepts showed considerable overlap in features. Twenty four distinct measures were identified which could be categorised as primarily measuring one of four facets of AI (oscillation, intensity, ability to regulate and affect change triggered by environment) or as measuring general emotional regulation.

Conclusions: A clearer definition of AI is required. We propose AI be defined as "rapid oscillations of intense affect, with a difficulty in regulating these oscillations or their behavioural consequences". No single measure comprehensively assesses AI and a combination of current measures is required for assessment. A new short measure of AI that is reliable and validated against external criteria is needed.

Introduction

Affective instability (AI) is widely described in the psychiatric literature but there is a lack of agreement and consistency in definitions (Links *et al.*, 2008, Trull *et al.*, 2008, Westen *et al.*, 1997). Definitions of AI incorporate frequent affective category shifts, disturbances in affect intensity, excessively rapid emotion rise-times and delayed return to baseline, excessive reactivity to psychosocial cues and overdramatic affective expression (Koenigsberg, 2010). The term is used interchangeably with mood instability, affective lability, affective and emotional dysregulation and mood swings, by researchers and clinicians alike. Operationalizing AI has proved difficult (MacKinnon and Pies, 2006), although statistical modelling and methods based on experience sampling applied in the short term (Ebner-Priemer *et al.*, 2009, Ebner-Priemer *et al.*, 2007a) and longer term (Bonsall *et al.*, 2012a) have been suggested.

Affective instability can be understood as a trait-like dimension or as a symptom profile representing a change from a premorbid state. As a trait and defined as "a marked reactivity of mood" in the Diagnostic and Statistical Manual –fourth edition (DSM-IV) (American Psychiatric Association, 2000) as a Borderline Personality Disorder (BLPD) criterion it has been estimated to have a general population prevalence of around 14% (Black *et al.*, 2006, Marwaha *et al.*, 2012). It is also clinically important as prospective studies show that, of all the BLPD diagnostic criteria, AI is the strongest predictor of suicidal behaviour, exceeding negative mood state in its effect (Yen *et al.*, 2004). Neuroticism (Korten *et al.*, 2012) and having more interpersonal difficulties with partners are both associated with AI as well as future depression (Miller and Pilkonis, 2006, Thompson *et al.*, 2011).

A very strong and consistent association between AI and attention deficit hyperactivity disorder (ADHD) has been shown. It has been argued that AI should be a diagnostic criterion for ADHD, given its high prevalence in this disorder and the overlapping neurobiological and cognitive features of those with AI and ADHD (Skirrow *et al.*, 2009). There is also evidence of a diminution of AI when present in ADHD in response to stimulant therapeutic agents both in children (Williams *et al.*, 2008) and adults (Reimherr *et al.*, 2007).

The clinical significance of AI extends outside of disorders in which it is understood as a trait. If conceptualised as a symptom profile AI encompasses a wide range of mental disorders. In

a prospective follow-up of army conscripts, cyclothymia (which was defined mainly as higher levels of AI) was a very significant predictor of transition to future bipolar disorder increasing the odds greatly, and having a larger effect than for family history of the illness (Angst *et al.*, 2003). Because of its importance it is considered a target for treatment in its own right in bipolar disorder (Henry *et al.*, 2008b). Affective instability is also frequent in depression (Bowen *et al.*, 2011b) and anxiety disorders (Bowen *et al.*, 2004). Though present in varied psychiatric disorders, it is uncertain whether what is being measured is the same or discrepant and this may lead to diagnostic confusion.

The imprecision and lack of clarity about this phenomenological construct, how the terms used to describe it are defined and the reliability and validity of the measures employed all combine to limit empirical research about AI and its clinical application. Our study objectives were to answer two main questions

a) What are the definitions of affective instability in clinical populations, in the scientific literature?

b) What are the available measures of affective instability and how reliable and valid are these?

Method

We conducted a systematic review of the literature and use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al.*, 2009) in this paper to describe our procedures and results.

Information sources

MEDLINE, EMBASE, PsycINFO, PsycArticles and Web of Science bibliographic databases were searched from their date of inception to February 2012. Reference lists of included studies were searched for relevant citations. Five journals were hand searched spanning the previous 5 years (from June 2007 to June 2012). These were: The American Journal of Psychiatry, Psychological Medicine, Journal of Abnormal Psychology, Journal of Affective Disorders and Journal of the American Academy of Child and Adolescent Psychiatry. These journals were those considered most likely to yield relevant papers after a scoping run of our search strategy.

Search

The research team discussed and reviewed the results of an initial scoping search. We developed a strategy using five groups of search terms. These were: affective instability, affective dysregulation, affective lability (group 1); mood instability, mood dysregulation, mood lability, mood swings (group 2); emotion instability, emotion dysregulation, emotion lability (group 3); borderline personality disorder, bipolar disorder, post-traumatic stress disorder (PTSD), and unstable personality traits (group 4); and Mood Disorder Questionnaire (MDQ) (Hirschfeld *et al.*, 2000), the Short Mood and Feelings Questionnaire (S-MFQ) (Sharp *et al.*, 2006), Affective Lability Scale (ALS) (Harvey *et al.*, 1989), Affective Intensity Measure (AIM) (Larsen *et al.*, 1986), Strength and Difficulties Questionnaire (Goodman, 1997), the Child Behaviour Checklist (Achenbach, 1991) (group 5). Cyclothymia was included in the search as a MESH term. The search was augmented in April 2013 by adding attention deficit hyperactivity disorder as a specific term (in group 4).

In summary the strategy was to include all relevant abstracts relating to groups 1, 2, 3 AND group 4, and groups 1, 2, 3 AND group 5. Terms were adapted as necessary for other databases. The exact search strategy and full list of terms as they were entered into MEDLINE are shown in box 1 of the supplementary material. Results were downloaded into ENDNOTE X5. The search included reviews and primary studies. If a previous review was found, we searched the reference list to identify and retrieve the primary studies.

Eligibility criteria

Studies were included if they met the following criteria:

a) Study design: experimental studies (randomized controlled trials, non-randomized controlled), controlled before-and-after studies, controlled observational studies (cohort and case control studies) and epidemiological investigations.
b) Comparison: we did not apply restrictions for comparison groups.
c) Participants: were adults over 18 years old and were defined as having a mental disorder if they met criteria as defined in the DSM-IV or ICD-10.
d) Definition: any definition of the AI term was provided
e) Measures: were defined as any assessments of AI including any paper-and-pencil or computer administered questionnaires or measures based on structured interviews.

Excluded studies were:

a) case reports
b) non-English language papers
c) cross cultural language validation studies
d) studies sampling people with organic disorders (eg brain injury, tumour, dementia etc)

Abstract screening

More than 11,000 abstracts were retrieved using our search strategy (N=11443). If a title appeared potentially eligible but no abstract was available, the full text article was retrieved. One researcher (ZH) scanned all titles and abstracts to identify relevant articles for full text retrieval. Another researcher (JE) independently assessed 50% of the abstracts to identify relevant articles. There was high level of agreement (80%) between raters. Any disagreements were referred to a third researcher (SM or MB) and then resolved by consensus.

Data collection process and assessment of quality

Data on study design, participants, definition and measurements were extracted from full text papers. Types of bias assessed in individual studies were selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias as suggested by the Cochrane Collaboration (Higgins and Green, 2011). Any uncertainties were referred to others in the study team for resolution.

Synthesis of results

In order to synthesise the very large number of abstracts generated by our search we partitioned the abstracts into three groups; those that focussed on measures in adults, in children and neurobiological measures. This paper addresses AI definitions and measures in the adult clinical populations. The included studies were heterogeneous in terms of definition and measurement of AI; hence we report a narrative synthesis of the findings. For each assessment scale we identified psychometric properties from the relevant manuscript or from the wider literature.

Results

Study selection

The PRISMA flowchart (figure 1) shows the process of identification and selection of papers. One hundred and ten full text articles were assessed of which 73 were excluded. The most common reasons for exclusion were because the publication did not provide a definition of AI or did not include a clinical sub-population in the sample.

Figure 1 about here

Study characteristics

Thirty seven primary studies were identified for final analysis. There were 2 RCTs and 35 non-randomized experimental design studies. There were no family or twin studies in the included papers. Further characteristics of included studies are shown in Table 1. Included studies were conducted in the USA, Europe, Canada or Australia. The sample size ranged from 20 to 1065, whilst the age range of participants included adults up to the age of 89 years old. One study included children as young as 8 years old but as the sample also included adults and the mean age of participants was 43.5 years (Thompson *et al.*, 2011) this study met our criteria for inclusion. The clinical groups included patients with anxiety disorders, bipolar disorder, major depressive disorder, mood disorders, personality disorder, posttraumatic stress disorder, social anxiety disorder, ADHD and schizophrenia.

Table 1 about here

Definitions of AI terms

Definitions of AI terms are listed in table 2 (online supplementary material), with references to the key studies that used them. Numbers of different definitions were: affective instability (N=7), affective lability (N=6), affective dysregulation (N=1), emotional dysregulation (N=4), emotion regulation (N=2), emotional lability (N=1), mood instability (N=2), mood lability (N=1) and mood swings (N=1)

The definitions for AI terms frequently emphasized significant fluctuations in affect and the intensity of these changes as core features. They were discrepant in whether negative mood was given special prominence, the extent of clinically significant impairment and/or whether environmental triggers were a necessary precipitant of change in affect. Exact information about the time period over which the affect lasted and the frequency of change were absent in

the vast majority of definitions, though descriptors such as “frequent” or “rapid” were used in some. Three definitions specified the frequency of affect change as lasting over a few hours and rarely more than a few days.

There did not appear to be relevant differences between the AI definitions specifically and those for affective lability or dysregulation, mood instability, lability or mood swings. However there was a lack of consistency in the number of facets (e.g. frequency, intensity) that were described or required in definitions of mood instability, lability or swings. Though the terms mood and affect were frequently used interchangeably in studies, mood is usually defined as a sustained emotional state (Wing *et al.*, 1974).

There was also a considerable overlap between the definitions for emotional dysregulation and those for dysregulation (e.g. lability, instability) of mood and affect. For example a number of studies purportedly focussed on affective instability incorporating intensity, lability and regulation but in the text went on to define the term emotional dysregulation (Conklin *et al.*, 2006, Marshall-Berenz *et al.*, 2011, Yen *et al.*, 2002). On the other hand some publications which were concerned with investigating emotional dysregulation, actually defined and measured what they described as affective instability in the text (Kroger *et al.*, 2011). One possible difference between definitions of emotional dysregulation compared to other search terms was the emphasis placed on the subjective lack of capacity to regulate or control affect and its behavioural sequelae.

The key features within the definitions of AI terms, in the main were not disorder specific. For example the term emotional lability used in the ADHD literature is defined as irritable moods with volatile and changeable emotions (Asherson, 2005, Skirrow and Asherson, 2013). This shared the characteristics of the term affective lability defined as rapid shifts in outward emotional expressions (Harvey *et al.*, 1989) used in the context of BLPD and bipolar disorder.

We refer to affective instability as the main comparison term from this point onwards as this label had the greatest number of definitions and many of the papers discussing the other terms listed in table 2 also referred to affective instability as an overarching term.

Measures of affective instability

A total of 24 measures are used to assess constructs labelled by various combinations of the words affective, mood, emotion, instability, lability, swings and dysregulation, with the majority being self-report. These are shown in table 3a alongside the available psychometric data and more details are given in table 3b (online supplementary material). Reliability assessments (using Cronbach's alpha) were available for most measures. These indicated moderate to excellent levels of internal consistency with alpha (α) values ranging from about 0.6 to 0.9. Test-retest, inter-rater reliability and validity assessments were uncommon**.** Some measures had no psychometric evaluation and these tended to be either bespoke instruments involving a few questions (e.g. Mood Lability Scale (MLS) (Akiskal *et al.*, 1995)) or one or two items related to AI extracted from interview assessments such as the Structured Clinical Interview for DSM (SCID).

Table 3a about here

Table 4 (online supplementary material) shows the different aspects of AI that were primarily addressed by each measure. These were rapid oscillations in affect, extent of affect intensity, the degree to which changes were endogenous or in response to cues, and the subjective capacity to regulate / control affect or behavioural sequelae. The measures that assessed this last component included items such as non-acceptance of negative emotions, inability to engage in goal-directed and non-impulsive behaviour when experiencing negative emotions, limited access to emotion regulation strategies (e.g. Difficulties in Emotion Regulation Scale (DERS) and emotional suppression and cognitive re-appraisal (e.g. Emotion Regulation Questionnaire (ERQ).

There were also other assessment scales such as the General Emotional Dysregulation Measure (GEDM) (Newhill *et al.*, 2004) that were broader in their scope and appeared to measure general emotional regulation. No measure primarily assessed emotional rise times and delayed return from heightened arousal, although these aspects were included as single items in some of the measures found.

AI measures and their use in different clinical groups

Table 5 shows which measures have been used in different mental disorders arranged according to the main aspects of AI purportedly assessed. Whilst AI has been measured in a wide range of mental disorders, those with BLPD and major depression were the most frequently sampled. For BLPD, measures have primarily assessed oscillation in affect, affect intensity and the capacity to control emotions and actions. The Affective Intensity Measure (AIM) was the most commonly used in this disorder, followed by the Affective Lability Scale (ALS) and the Affective Control Scale (ACS) (Williams *et al.*, 1997). The ALS and AIM were also commonly used to measure AI in studies focussing on other personality disorders.

Ten studies focussed on depressive disorder with no real preponderance of a particular set of measures and covered all aspects of AI as well as general emotional regulation. Affective instability using the measures identified has been rarely investigated in bipolar disorder. There were three studies which sampled people with ADHD and used four different measures, only one of which (ALS) has been used in other diagnostic groups. Apart from this no clear pattern emerged in terms of particular AI measures being preferred in particular disorders with most having being used in at least three different mental disorders whether as measures of trait or state AI.

Table 5 about here

Risk of bias within primary studies

Only two included studies were RCTs (Conklin *et al.*, 2006, Reimherr *et al.*, 2005) but the risk of selection bias was judged to be unclear as insufficient information was provided on random sequence generation and allocation concealment to allow an assessment of risk. All non-RCTs were judged to be at high risk of selection biases. The performance bias and detection bias were judged to be high in all included studies as participants could not be blinded to group allocation by the nature of the self-reported outcomes. The risk of attrition bias and outcome reporting bias was judged to be low in all studies.

Discussion

As far as we are aware this is the first systematic review of this subject in adult clinical populations.

Conceptualisation of affective instability

The distinction between affective states in personality disorders which are described as traits and such disturbances in other mental disorders described as symptoms is largely artificial and their delineation is far from clear. When AI is described as a trait, part of this characterisation relies on the assumption that AI is somehow inherent and stably expressed over time. However, the stability of a BLPD diagnosis over 2yrs is 20-40% with AI being one of the least stable features (Chanen *et al.*, 2004, Garnet *et al.*, 1994). Longer term stability is far less clear. Affective instability also has trait like properties in ADHD, a neurodevelopmental disorder. The fact that ADHD and BPLD co-occur (Faraone *et al.*, 2000) and both groups have difficulties with affect regulation makes differential diagnosis difficult and further clouds the issue of the specificity of AI being a trait of personality.

Considering AI to be purely a symptom does not sit neatly with findings suggesting that levels of AI are relatively high in people with bipolar disorder even in the absence of syndromal depression or elation (Bonsall *et al.*, 2012b). Also the frequency of affective fluctuation in bipolar spectrum disorders may be so large as to resemble that in BLPD (MacKinnon and Pies, 2006). These findings suggest that conceptualisations of AI as being a trait or symptom are not wholly mutually exclusive and neither does this dichotomous framework fully explain empirical findings.

Interestingly the vast bulk of definitions that we found were not specifically linked with conceptualising AI within a particular theoretical framework. There were three exceptions to this, two of which framed AI as a trait (Benazzi and Akiskal, 2005, Ozgurdal *et al.*, 2009) and a further definition suggesting affective lability was particularly relevant to both BLPD and bipolar spectrum disorders (Look *et al.*, 2010). This lack of specificity between theoretical framework and definitions and the associated measures means that AI is not only poorly understood but the use of different measures is not contingent on framing AI as a trait or symptom.

Definition of affective instability

The terms affective, mood or emotional instability, lability or regulation are used interchangeably because they are largely defined by similar attributes. One possible higher level difference in definitions incorporating emotional and affective or mood terms is that the former mainly emphasizes the capacity to regulate affect, whereas the latter prioritizes the change of affect itself. The measures assess four core attributes. These are rapid oscillation and intensity of affect, a subjective sense of the capacity to control affect and its behavioural consequences and whether affect change is triggered in response to environment or not. Examples of behavioural consequences of affective change in measures are "auto-aggression", ability to engage in non-impulsive behaviours, and fears of becoming violent if furious. These four attributes of AI in measures also reflect commonalities within the definitions that were identified.

Our analysis indicates that AI as it is defined and measured is a broad concept. We propose a definition of AI that incorporates the three core elements of oscillation, intensity and subjective ability to regulate affect and its behavioural consequences. Thus AI is defined as "rapid oscillations of intense affect, with a difficulty in regulating these oscillations or their behavioural consequences". The proposed definition would enable much of the varied lexicon in this area to be absorbed into the single term affective instability and has the advantage of not being reliant on a specific theoretical framework.

Definitions and measures were not clear about whether the affective changes are always in response to environmental cues and therefore we have not included this as part of our definition. Whether there is an environmental trigger may be disorder specific. The timeframe over which fluctuations of affect occur was usually absent in the reviewed definitions and therefore this also is not specified in our definition. We have excluded broader problems in emotional functioning from our definition because of its imprecision. A combination of current measures will be required to assess AI comprehensively if our definition is applied.

Evaluation of measures

Given the definition that we have proposed a number of the measures identified should be preferentially used in assessing AI. There were two measures specifically assessing rapid oscillation of affect. The Affective Lability Scale (ALS) (Harvey *et al.*, 1989) has good internal consistency and is also the most frequently used measure in this area by far, having been used in all clinical diagnostic groups apart from schizophrenia and anxiety disorders. The Emotion Dysregulation Scale (EDS) (Kroger *et al.*, 2011) also has good internal consistency but the scale focuses on affect dysregulation as well as impulsivity found in BLPD specifically and therefore the ALS may be more generally applicable. In terms of affect intensity, the Affective Intensity Measure (AIM) (Larsen *et al.*, 1986) is a self-report measure demonstrating good internal consistency, test-retest reliability and also construct validity.

The third element of our proposed definition of AI is the capacity to regulate affect or its behavioural consequences. Whilst the Difficulties in Emotion Regulation Scale (DERS) is comprehensive and has strong psychometric properties (Gratz and Gunderson, 2006) it is limited by the items only referring to feeling low or upset. In comparison the Affective Control Scale (ACS) (Williams *et al.*, 1997), assesses regulation difficulties in a range of affect states (including happiness) and also has very good reliability and construct validity (Berg *et al.*, 1998, Williams *et al.*, 1997).

The assessment of available measures suggests that one possible scientifically useful way (though there may be others) to measure AI would be to use the ALS, AIM and the ACS in combination. However further validation of this approach is required, in part because studies that have used the ALS and AIM in bipolar disorder (Henry *et al.*, 2008a) and BLPD populations (Koenigsberg *et al.*, 2002) indicate that whilst both measures provide useful complimentary information, their scores are not independent of each other. Secondly studies using ecological momentary assessments (EMA) to measure real time experiences of affect intensity and change suggest only modest levels of correlation at best, between EMA and measures such as the ALS and AIM (Solhan *et al.*, 2009).

Measures of affective instability and clinical disorders

The ALS is commonly used in BLPD in particular. Three measures used in studies sampling ADHD were not used in other mental disorders. The Impulsivity/Emotional Lability scale (I/ELS) and Centre for Neurologic Study-Lability Scale (CNS-LS) primarily measures fluctuation in affect as does the relevant subscale of the Wender-Reimherr Adult Attention Deficit Disorder Scale (WRAADDS). However the questions used to assess AI in these measures as well as the definitions of AI terms from the ADHD and BLPD literature did not markedly differ in their quality and nature to those used in other clinical disorders.

Therefore apart from a few exceptions no clear pattern emerged in terms of preference for individual scales of AI in different disorders. These findings can be interpreted in a number of ways. First, it indicates that no overall gold standard for measurement exists so far. This in turn is likely to be a reflection of the level of scientific knowledge about the phenomenological construct, which will need to explain whether AI is the same in different psychiatric disorders. One possible explanatory framework for the lack of specificity of particular measures and individual mental disorders is that AI, as it is currently understood is on the continuum from trait to psychopathology.

This framework is supported by our results in that a wide range of AI definitions were listed in the literature. Also AI is present very early in the course of a number of major mental disorders including bipolar disorder (Howes *et al.*, 2011), BLPD (Wolke *et al.*, 2012, Zanarini *et al.*, 2011) and major depression suggesting that there is some differentiation over time from a non-specific symptom to disorder. Furthermore, this would be consistent with preliminary comparison studies of the extent of oscillation and intensity of affect in bipolar disorder and BLPD, which suggest similarities but also a range of subtle differences (Henry *et al.*, 2001). Having a definition and measure of AI opens the opportunity to study how a predisposition for AI interacts with other factors to lead to a range of affect related disorders.

The AI measures currently available have been most frequently used in the assessment of BLPD. They have the potential for utility in clinical practice to help mental health professionals understand the extent of symptomatology in BLPD given the good psychometric properties observed. It is unclear whether they can be used in intervention research studies given that we found none, which were proven to be sensitive to change. In

the ADHD context, the measures appear to have been used to understand AI in this disorder (e.g. CNS-LS) and also to assess change in treatment trials (e.g WRAADDS) but their utility in routine clinical practice remains to be seen. Without further studies the measures cannot be recommended for routine clinical use in people with mood disorders as there is a paucity of validation studies in mood disorders in comparison to BLPD.

Limitations

The current review only included reports in the English language and as such there may be other measures or definitions of AI that were not considered. Similarly papers that sampled non clinical populations were excluded and our conclusions may not be applicable to that group. We did not use the search term emotional impulsiveness. This is a term primarily linked to the ADHD literature with the term being defined as "the quickness or speed with which and the greater likelihood that an individual with ADHD will react with negative emotions in response to events relative to others of the same developmental age" (Barkley and Murphy, 2010). Its omission was consistent with our strategy of neutrality with regards to the conceptualisation of AI. There is also overlap between this term and emotional dysregulation which we did include (Mitchell *et al.*, 2012).

All measurements of AI were related to current mental state but there was a lack of clarity about severity or phase of the clinical disorder being sampled in the primary studies. Patient populations were sampled from a broad range of settings (community, outpatients, inpatients, partial hospitalization) but it was uncommon to find a clear description of whether these were general or specialist services. Therefore we cannot comment on whether the current evidence base in biased in this respect.

There is likely to be a bias in the scientific literature on AI based on diagnosis. That is, whilst AI can occur in a range of mental disorders it is a diagnostic criterion for BLPD and therefore researchers are likely to have focussed on this disorder. This bias was borne out in our review.

Implications for future research

Our clear and reproducible definition of AI has a number of potential implications for future research and the understanding of the development of a range of mental disorders. First, it has been argued that for inclusion in the DSM-5 a mental disorder should have proven

psychobiological disruption (Stein *et al.*, 2010). AI appears important in the pathway to a number of mental disorders as well as in established illness and consistent definition and measurement opens up opportunities to assess alterations in brain activity and other physiological systems. Our current understanding suggests AI conceptualised as a trait may be influenced by genetic components representing emotional intensity and reactivity (Livesley and Jang, 2008). Future studies are required to address whether AI occurs as a syndrome in any specific neurological or genetic disorders.

Secondly, no single measure assesses all core elements of AI. There is clear scope for the development and psychometric evaluation of a measure of AI that assesses rapid oscillations of affect, intensity of affective change and subjective capacity to regulate affect and is short, reliable and validated against external criteria. Other than developing a completely new instrument this could be achieved by factor analysis of responses to the recommended measures above.

Alongside the need to develop a single measure of AI that covers all its core elements it is necessary to more thoroughly understand the time-dependent nature of instability in order to further refine our definition. The most effective way of doing this would be to use ecological momentary assessments of mood which can enable a prospective assessment of moment-to-moment changes in affect, avoiding retrospective recall bias. Knowledge of timeframes over which fluctuations occur could then be embedded into less labour intensive methods of assessment. Thirdly, clarification is necessary on the extent to which affective shifts and their duration reflect endogenous changes or occur in response to environmental stimuli and what these are, whether they cause clinically significant impairment in functioning or mental state and whether negative emotions should be given special prominence as is suggested by a number of researchers.

Fourthly, further research should examine if the form of AI is similar across the full range of mental disorders in which it occurs or whether disorder specific characteristics of AI exist. Case control studies are needed in which AI is assessed in different mental disorders using the same measurement methods. These should especially focus in particular on bipolar disorder, depression and psychosis as currently little is known about the characteristics of AI in these disorders. Finally, longitudinal studies are necessary to examine the expression and

possible differentiation of AI over time, including through developmental stage and how environmental influences may put individuals on different AI trajectories. This will enable insights into whether AI has particular relevance to certain conditions or is simply a general outcome of abnormal psychopathology.

Acknowledgements

This work was in part, funded by a grant from the Mental Health Research Network (MHRN) UK, Heart of England Hub. We declare there are no conflicts of interest.

Table 1 Characteristics of included studies (n=37)

First author/Year	Clinical group	Country	Sample size	Participants' age	Patients' setting	Definitions see table 2 online supplementary material	Measures
Group 1 AI terms as affective instability, affective dysregulation and affective lability							
Anestis, 2011 (Anestis *et al.*, 2011)	Mixed mental disorders (mostly BPD)	USA	127	R=18-60 y, M=35.69 y (SD 11.32)	Unknown	Used own definition.	ALS and AIM
Conklin, 2006 (Conklin *et al.*, 2006)	BPD	USA	117, BPD=90, dysthymic disorder=26	M=37 y	Unknown	According to Linehan and Heard (1992) (Linehan and Heard, 1992), Shedler and Westen (2004) (Shedler and Westen, 2004) and Westen (1991, 1998) (Westen, 1991), used own definition.	AREQ-QV
Henry, 2001 (Henry et al., 2001)	PD	USA	148	M=38 y	Outpatients	According to Clayton et al., 1994 (Clayton et al., 1994) and Lauer et al., 1997 (Lauer et al., 1997), used own definition.	ALS and AIM
Henry, 2008 (Henry *et al.*, 2008a)	BP	France	BP=179, C=86	BP M=39.17 y (SD 12.19), C: M=41.67 y (SD 11.60)	Two psychiatric hospitals (Paris and Bordeaux, France)	According to Siever and Davis (1991) (Siever and Davis, 1991) used own definition.	ALS and AIM
Kamen, 2010 (Kamen et al., 2010)	PD	USA	48	R=18-59 y, M=28.5 y	Outpatient	According to Harvey et al. (1989) (Harvey et al., 1989), used own definition.	ALS
Koenigsberg, 2002 (Koenigsberg *et al.*, 2002)	BPD	USA	152	M=37.6 y (SD=10.3)	Outpatients	DSM-III and DSM-IV	ALS and AIM
Kroger, 2011 (Kroger *et al.*, 2011)	Mixed mental disorders	Germany	168	M=32.14 y (SD=10.78)	Outpatients	DSM-III	EDS from IS-27
Links, 2008 (Links *et al.*, 2008)	BPD	Canada	82	R=18-65 y	Outpatient	Links's 4 elements definition (Links *et al.*, 2008).	VAS
Look, 2010 (Look et al., 2010)	PD	USA	Cluster B=236, Other PD=180,	Cluster B: M=35.08 y (SD=10.4), OPD: M=36.24y (SD=12.1),	Mood and Personality Disorders Research Program through	According to Henry et al. (2001) (Henry et al., 2001) and Koenigsberg et al. (2002) (Koenigsberg et al., 2002), used	ALS-S

First author/Year	Clinical group	Country	Sample size	Participants' age	Patients' setting	Definitions see table 2 online supplementary material	Measures
			C=164	C: M=30.04 y (SD=9.2)	advertisements and clinical referrals	own definition.	
Miller, 2006 (Miller and Pilkonis, 2006)	Mixed mental disorders	USA	132	R=20–59 y M=34.9 y (SD=9.4)	Inpatient and outpatient programs	DSM-IV	DSM-III-R
Reich, 2009 (Reich *et al.*, 2009)	BPD	USA	BPD=28	R=18-64 y	Selected patients through websites and advertising on local radio and television stations	DSM-IV	ALS
Reimherr, 2005 (Reimherr *et al.*, 2005)	ADHD	USA	Randomized ADHD: n=536, ADHD with ED: n=170, ADHD without ED: n=359	Randomized ADHD: M=41.2 y (SD=11.2), ADHD with ED: M=39.7 y (SD=10.3), ADHD without ED: M=41.9 y (SD=11.6)	Recruited from clinic referrals, by local advertisement, and through a central solicitation program.	Used own definition.	WRAADDS
Rihmer, 2010 (Rihmer and Benazzi, 2010)	BP and MDD	Hungary	BP=138, MDD=71	BP: M=39.0 y (SD=9.8), MDD: M=39.2 y (SD=10.6)	Outpatients	DSM-IV	SCID-CV and SCID-II
Thompson, 2011 (Thompson *et al.*, 2011)	MDD	USA	Study 1=288, Study 2=142, Study 3=101	R=8-89 y, M=43.5 y (SD=17.6)	Community sample	Used own definition.	PDI-IV, SCID-I
Trull, 2008 (Trull *et al.*, 2008)	BPD and MDD	USA	BPD=34, MDD=26	M=34.98 y (SD=12.25)	Outpatients	According to American Psychiatric Association (APA) (2000) (American Psychiatric Association, 2000) and Gunderson (2001) (Gunderson, 2001), used own definition.	EMA and DSM-IV Axis I

First author/Year	Clinical group	Country	Sample size	Participants' age	Patients' setting	Definitions see table 2 online supplementary material	Measures
Woyshville, 1999 (Woyshville *et al.*, 1999)	Mixed mental disorders	USA	Patients=36, C=27	Patients: M=36.7 y (SD=0.21), R=14-60 y C: M=23.37 y (SD=3.45), R=18-30 y	Mood Disorders Program (Department of Psychiatry, Case Western Reserve University)	According to Kraepelin (1921) (Kraepelin, 1921), used own definition.	VAS
Group 2 AI terms as emotional dysregulation, lability, instability							
Bornovalova, 2008 (Bornovalova *et al.*, 2008)	BPD	USA	76, BPD=25	R=18-62 y, M=42.21 y	Inpatient residents in a drug and alcohol abuse treatment centre	Gratz & Roemer's definition (2004) (Gratz and Roemer, 2004)	DERS
Campbell-Sills, 2006 (Campbell-Sills et al., 2006)	AD and MD	USA	Patients=60, C=30	R=18-75 y, M=34.01 y	Center for Anxiety and Related Disorders at Boston University	Gross's definition (2002) (Gross, 2002)	REQ
Coutinho, 2010 (Coutinho et al., 2010)	Undefined clinical group	Portugal	General population: 324	R=17-68 y M=28 (SD = 10.2)	Community sample	Gross's definition (1998) (Gross, 1998)	DERS
Ebner-Priemer, 2007 (Ebner-Priemer *et al.*, 2007b)	BPD	USA and Germany	BPD=50, C=51	BPD: M=31.3 (SD=8.1), C: M=27.7 (SD=6.8)	Unclear	Linehan's definition (1993) (Linehan, 1993)	EMA
Gratz, 2006b (Gratz *et al.*, 2006)	BPD	USA	BPD=17, C=18	BPD: M=34.06 y(SD=11.25), C: M=37.33 y(SD=12.08)	Outpatients	Gratz & Roemer's definition (2004) (Gratz and Roemer, 2004)	DERS
Gratz, 2006a (Gratz and Gunderson, 2006)	BPD	USA	BPD=22	R=19-58 y, M=33.32 y (SD = 9.98)	McLean Hospital and in private practice	Gratz & Roemer's definition (2004) (Gratz and Roemer, 2004)	DERS
Henry, 2008 (Henry et al., 2008c)	Schizophrenia	Australia	Sch=41, C=38	Sch: M=37.5 y (SD=10.67), C: M=36.1 y (SD=11.99)	Outpatients / inpatients	Kring and Werner' definition (2004) (Kring, 2004)	ERQ

First author/Year	Clinical group	Country	Sample size	Participants' age	Patients' setting	Definitions see table 2 online supplementary material	Measures
Liverant, 2008 (Liverant et al., 2008)	MDD or dysthymia	USA	60	R=17-58 y, M=28.5 y (SD=13.02)	Outpatients	Gross's definition (1998, 1999) (Gross, 1998, Gross, 1999)	ACS and ERS
Marshall-Berenz, 2011 (Marshall-Berenz et al., 2011)	BPD and PTSD	USA	67	M=38 y (SD=10)	Inpatients, community mental health centers, and newspaper and flier advertisements.	According to McGlashan (2005) (McGlashan et al., 2005) used own definition	ALS and AIM
Mitchell, 2012 (Mitchell *et al.*, 2012)	ADHD	USA	ADHD=18, C=23	ADHD: M=24.83 y (SD=4.93), C: M=22.61 y (SD=5.60)	ADHD specialty clinic and from a local public university (NC USA).	Gratz & Roemer's definition (2004) (Gratz and Roemer, 2004)	I/ELS
Newhill, 2004 (Newhill et al., 2004)	Cluster B PD	USA	100	R=18-60 y	Inpatient units / Outpatients	Linehan's definition (1993) (Linehan, 1993)	AIM, EDM, GEDM, and TAS
Skirrow, 2013 (Skirrow and Asherson, 2013)	ADHD	UK	ADHD: n=41, C: n=47	ADHD: M=28.5 y (SD=9.5), C: M=29.0 y (SD=10.4)	Waiting list of the National Adult ADHD Clinic	According to DSM-IV; Asherson, 2005; Reimherr et al., 2010 (Asherson, 2005, Reimherr *et al.*, 2010), used own definition.	ALS-S, CNS-LS
Werner, 2011 (Werner *et al.*, 2011)	SAD	USA	SAD=48, C=33	SAD: M=33 y (SD=8.2), C: M=33 y (SD=9.4)	Community sample	According to Campbell-Sills and Barlow (2007) (Campbell-Sills, 2007) and Werner and Gross (2009) (Werner, 2009), used own definition.	ERI and ERQ
Yen, 2002 (Yen *et al.*, 2002)	BPD	USA	BPD=39	M=35.5 y	5-day partial hospitalization program for women	Linehan's definition (1993) (Linehan, 1993)	AIM and ACS
Group 3 AI terms as mood instability, mood lability and mood swings							
Benazzi, 2005 (Benazzi and Akiskal, 2005)	BP and MDD	Italy	BP=62, MDD=59	M=44.6 y	Private outpatient	Akiskal et al.'s definition (1995, 2003) (Akiskal *et al.*, 1995)	MLS

First author/Year	Clinical group	Country	Sample size	Participants' age	Patients' setting	Definitions see table 2 online supplementary material	Measures
Bowen, 2011a (Bowen *et al.*, 2011b)	MDD	Canada	129	R=19-76 y, M=40.07 y	Inpatients / Outpatients	Trull et al.'s definition (2008) (Trull *et al.*, 2008)	ALS-S
Bowen, 2011b (Bowen *et al.*, 2011a)	Depression	Canada	34	R=17-63 y, M=37 y	Private practices	According to previous research, used own definition.	VAS
Bowen, 2004 (Bowen *et al.*, 2004)	AD	Canada	AD=20, C=22	AD: M=28.0 y, C: M=28.5 y	Private practices	Akiskal et al.'s definition (2000) (Akiskal *et al.*, 2000)	VAS
Bowen, 2006 (Bowen *et al.*, 2006)	AD	Canada	AD=28, C=28	AD: M=25.3 y, C: M=36.3 y	Outpatients	Akiskal et al.'s definition (1998) (Akiskal *et al.*, 1998)	Temps-A
Ozgurdal, 2009 (Ozgurdal et al., 2009)	BP	Germany	20	M=43.85 y (SD=9.38)	University department of Psychiatry	Used own definition.	Temps-A
Solhan, 2009 (Solhan et al., 2009)	BPD, MDD	USA	BPD=58, MDD=42	R=18-65 y	Outpatients	Used own definition.	PAI-BOR, ALS and AIM

Notes: anxiety disorders (AD), Attention-deficit hyperactivity disorder (ADHD), bipolar disorder (BP), major depressive disorder (MDD), mood disorders (MD), personality disorder (PD),posttraumatic stress disorder (PTSD), social anxiety disorder (SAD), schizophrenia (Sch), emotional dysregulated (ED), C=control group , M= mean age, R= age range, SD= standard deviation, y= years

Table 3a Questionnaires (n=24) used in the included studies.

	Name of the full questionnaires	Reliability and validity
ACS	Affective Control Scale (Williams et al., 1997)	IC and test-retest reliability α=0.94. Discriminant validity: r= -0.17 Convergent validity: r = -0.72
ALS	Affective Lability Scale (Harvey et al., 1989)	IC: α=0.72-0.99.
ALS-S	Affective Lability Scale Short Form (Oliver and Simons, 2004)	Validity: r=0.94.
AIM	Affective Intensity Measure (Larsen et al., 1986)	IC: α=0.90-0.94. Test retest correlations: 0.81 Construct validity: Correlated 0.52/ 0.61.
AREQ-QV	Affect Regulation and Experience Q-sort-Questionnaire Version (Westen et al., 1997)	IC: Affective experience α=0.71 to 0.76. Affect regulation factors α=0.81 to 0.92. Validity: r=0.62.
CNS-LS	Auxiliary subscale of the Centre for Neurologic Study-Lability Scale (Moore et al., 1997).	IC: α=0.86 (Moore et al., 1997).
DERS	Difficulties in Emotion Regulation Scale (Gratz and Roemer, 2004)	IC: α=0.91-0.93. Validity: r=0.63.
DSM-IIIR	(American Psychiatric Association, 2000)	IC α= 0.68.
EDM	Emotion Dysregulation Measure (Newhill et al., 2004)	IC: α=0.76 Test-retest reliability r=0.83.
EDS	Emotion Dysregulation Scale from IS-27, (Kroger, 2010))	IC: α=0.90-0.93. Corrected item-scale (r=0.65-0.80).
EMA	Ecological Momentary Assessment (Stone *et al.*, 2002, Stone and Shiffman, 1994)	No information was reported.
ERI	Emotion Regulation Interview (Gross, 1998)	Test re-test reliability:Range from 0.55 to 0.77. Convergent validity of ERI was

	Name of the full questionnaires	Reliability and validity
		significantly (<0.05).
ERQ	Emotion Regulation Questionnaire (Gross and John, 2003)	IC: α for Reappraisal was 0.79 and for Suppression was 0.73. Test–retest reliability, r=0.69.
ERS	Emotion Regulation Scale (Liverant et al., 2008)	No information was reported.
GEDM	General Emotional Dysregulation Measure (Newhill et al., 2004)	IC: α=0.82-0.84. Test-retest correlation =0.81; $p < 0.01$. Convergent validity: r=0.30; $p < 0.01$).
I/ELS	Impulsivity/Emotional Lability scale from the Conners Adult ADHD Rating Scale (CAARS, (Conners et al., 1999)).	IC for scale: α=0.94 IC for revised subscale α=0.88.
MLS	Mood lability scale (Akiskal et al., 1995)	No information was reported.
PAI-BOR	Personality Assessment Inventory – Borderline Features Scale (Morey, 1991)	IC for whole scale α=0.70.
PDI-IV	Personality Disorder Interview-IV (Widiger, 1995)	Inter-rater reliability: intraclass correlation coefficient=0.90
REQ	Responses to Emotions Questionnaire (Campbell-Sills et al., 2006)	Not known.
TEMPS-A	Temperament Evaluation of the Memphis, Pisa, Paris, and San Diego Auto questionnaire (Akiskal et al., 2005)	IC: α=0.91 (cyclothymic).
SCID-II	Structured Clinical Interview for DSM-IV Axis II Personality Disorders (American Psychiatric Association, 2000)	No information available for affective instability probes specifically.
VAS	Visual analogue scale (Bernstein and Garfinkel, 1992, Hotopf et al., 1999)	Not known.
WRAADDS	Wender-Reimherr Adult Attention Deficit Disorder Scale (Wender, 1995)	IC: α=0.82.

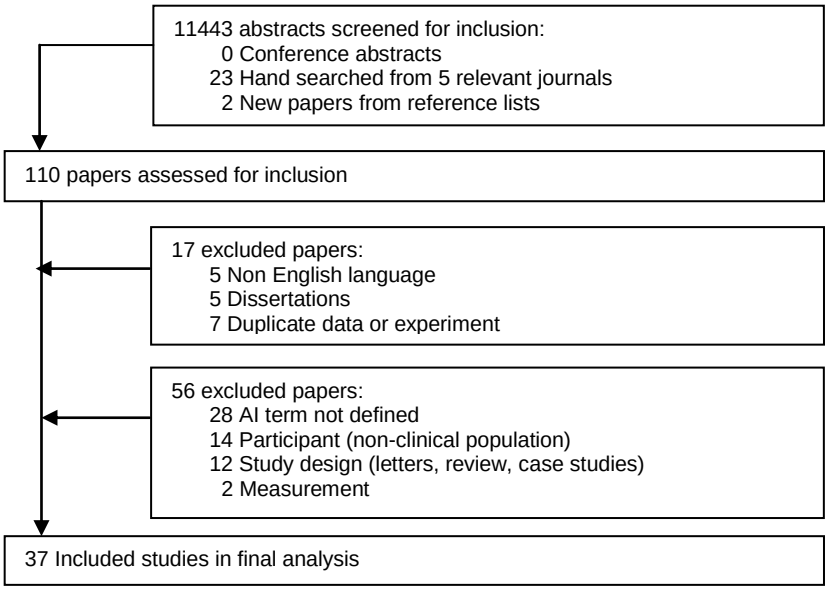
Note: IC: internal Consistency. For detailed information please see online supplementary material, which included questionnaires' description, reliability and validity.

Table 5 Clinical groups and AI questionnaires

Clinical groups (number of studies◊)	Name of questionnaires (number of studies*)				
	Rapid oscillation	**Affect intensity**	**Affect change in reaction to cues or endogenously**	**Capacity to control emotions or actions**	**General emotional regulation**
Attention-deficit hyperactivity disorder (3)	I/ELS (1) ALS-S (1) WRAADDS (1) CNS-LS (1)			WRAADDS (1)	
Anxiety Disorders (3)		VAS (2)			Temps-A (1)
Bipolar disorder (4)	MLS (1) ALS (1)	AIM (1)	SCID (2)		Temps-A (1)
Borderline PD (13)	ALS (3), EMA (2)	AIM (5) ,PAI-BOR (1), VAS (1)		ACS (3), DERS (3)	AREQ-QV (1)
Depression (1)		VAS (1)			
Dysthymia (1)				ACS (1)	ERS (1)
Mood Disorder (1)				REQ (1)	
Major Depression (7)	ALS (1), ALS-S (1) EMA (1), MLS (1)	AIM (1), PAI-BOR (1), PDI-IV (1)	SCID (3)	ACS (1)	ERS (1)
Personality Disorder (4)	ALS (2), ALS-S (1)	AIM (2), TAS (1)		EDM (1)	GEDM (1)
PTSD (1)	ALS (1)	AIM (1)			
Social Anxiety Disorder (1)				ERI (1), ERQ (1)	
Schizophrenia (1)				ERQ (1)	
Clinical diagnostic group not defined (1)				DERS (1)	

Note: ◊indicates the number of included studies which were conducted in certain clinical group. *It indicates the number of included studies which used the questionnaire for this clinical group.

Figure 1: PRISMA flowchart



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