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The Besançon Affective Picture Set-Adolescents (the BAPS-Ado): Development and validation



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ABSTRACT

Emotional pictures are commonly used as visual stimuli in a number of research fields. Choosing relevant visual stimuli to induce emotion is fundamental in attachment and affective research. Attachment theory provides a theoretical basis for the understanding of emotional and relational problems, and is especially related to two specific emotions: distress and comfort. The lack of normalized visual stimuli soliciting these attachment-related emotions has led us to create and validate a new photographic database: the Besançon Affective Picture Set-Adolescents. This novel stimulus set is composed of 93 photographs, divided into four categories: distress, comfort, joy-complicity and neutral. A group of 140 adolescents rated the pictures with the Self-Assessment Manikin system, yielding three dimensions: valence, emotional arousal, and dominance. The pictures were also assessed, using a continuous scale, for different emotions (distress, hate, horror, comfort, complicity and joy). The ANOVAs for arousal and the Kruskal–Wallis tests for valence and dominance showed strong effects for category. However, for comfort and complicity, the dimensions of valence and dominance were not significantly different, while results for arousal showed no significant difference between complicity and distress. Our study provides a tool that allows researchers to select visual stimuli to investigate attachment-related emotion processing in adolescence.

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1. Introduction

Most emotion theorists admit that emotions are most frequently and actively experienced in the context of close relationships (Ekman, 1994). Over the past three decades, attachment theory has become one of the most important frameworks for understanding emotions related to interpersonal relationships (Mikulincer and Florian, 1998). According to this theory, repeated interactions with a supportive and sensitive caregiver allow a child to develop a stable cognitive-emotional scheme of the caregiver's availability for reducing stress (Bowlby, 1977, 1982), and providing comfort and protection in potentially threatening situations (Hennighausen et al., 2011).

These early experiences may be regulated or disordered, and will differ by imprinting either secure, insecure (avoidant, anxious), or disorganized attachment (Ainsworth et al., 1978; Main and Solomon, 1986). These attachment patterns are consistent from infancy to

adulthood, and will become part of the general interpersonal scheme for an individual.

Based on perceived security, they will influence strategies to regulate closeness–distance toward the attachment figure, as well as strategies for expressing or inhibiting emotions (Mikulincer and Florian, 1998; Kobak et al., 2006), which are core features of social functioning. In the context of attachment relationships, some emotions, such as distress and comfort, are more attachment-relevant than others. During adolescence, young people undergo a process of individuation–separation and profound socio-emotional changes (Lerner and Steinberg, 2004). Throughout this period, attachment functions as a stress regulator (Allen, 2008b), mediating internal security and proximity access, while emotion dysregulation is often linked to an increased rate of psychopathology (Rosenstein and Horowitz, 1996; Hunter et al., 2011).

Traditionally, clinical research on attachment-related emotion processing has relied mainly on self-reports or interviews. Physiological measurements (cortisol levels and heart rate) are rarely used in an attachment paradigm (Beijersbergen et al., 2006; Hennighausen et al., 2011). However, some researchers have developed visual stimuli to activate the attachment system and

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evaluate attachment-related emotions: the Adult Attachment Projective (AAP, [George and West, 2001](#)), an attachment-related picture system based on seven drawings depicting attachment-related events (e.g., illness, solitude, separation, loss, and abuse), and the Separation Anxiety Test (SAT, [Klagsbrun and Bowlby, 1976](#)) with six pictures, mainly about separation from a parent. These tools seek to analyze the individual's carefully constructed defensive maneuvers when facing attachment-related emotions, which might have been "locked away", and thus excluded from attention and memory ([George and West, 2001](#)). Attachment representation in adults is assessed by analysis of the individual's narrative responses to the drawings. The AAP classification system uses evaluations of three dimensions (Discourse, Content and Defensive Processing), and the SAT uses similar assessments. Although such strategies are useful to identify some aspects of attachment-related emotion processing, many components of physiological responses are not available for self-reports or interviews, in particular the emotions felt before responses have been distorted and modulated through cognitive processes (such as deactivation and cognitive disconnection).

Studying emotion regulation in adolescence poses several challenges. For example, adolescents tend to develop increasingly sophisticated means of hiding or masking their emotions and are also not always aware of them. Observational assessment of emotion regulation in adolescents is therefore more complex, making it imperative to measure different indicators during this period ([Hunter et al., 2011](#)).

We need to fill the gap between the more representational cognitive strategies of attachment and the physiological correlates of attachment-related emotions in adolescence. Researchers need to develop new tools to assess the neurophysiological correlates of attachment-emotion disturbances and to clarify the development of emotional regulation, particularly in adolescence.

In order to induce emotions, many standardized stimuli are employed, like photographs (e.g., The International Affective Picture System, [Lang et al., 2008](#)), words (e.g., The Affective Norms for English Words, [Bradley and Lang, 1999](#)) and sound (e.g., The International Affective Digitized Sound system, [Bradley and Lang, 2007](#)). However, it has been shown that pictures displaying social scenes elicit more intense emotional responses, and also allow the comparison and replication of experiments in the laboratory ([Bradley and Lang, 2000](#)). When viewing pictures, different physiological patterns are found in the somatic and central systems, which vary significantly with level of valence and emotional arousal ([Bradley and Lang, 2000](#); [Bradley et al., 2001](#)). Emotional pictures elicit differential effects on RR interval variation and sympathetic skin response in the viewer ([Bernat et al., 2006](#)). Several photographic databases have been used to analyze emotional behavior, mainly in research on cognition ([Sanchez-Navarro et al., 2006](#)), object perception, and emotion recognition ([Mayer and Salovey, 1995](#); [Junghofer et al., 2001](#); [Chavis and Kisley, 2012](#)). Most of these databases focus on facial expressions, with professional actors expressing basic emotions from prototypes defined in the Facial Action Coding System ([Cohn et al., 2006](#); [Langner et al., 2010](#)), for example, the Radboud Faces Database ([Langner et al., 2010](#)) and the Karolinska Directed Emotional Faces ([Calvo and Lundqvist, 2008](#)). At present, few databases contain affective photographs with validated normative ratings: the International Affective Picture System ([Lang et al., 2008](#)), and the Geneva Affective Picture Database ([Dan-Glauser and Scherer, 2011](#)). Nevertheless, the lack of discrimination between specific emotions other than negative and positive valence has been underlined ([Dan-Glauser and Scherer, 2011](#)). Despite their benefits, they rarely evoke attachment-related emotions.

This broad and constant need for emotional pictures in the field of attachment science led us to create a new photographic

database of attachment-related emotions: The Besançon Affective Picture Set-Adolescents (The BAPS-Ado). Emotions are considered here as synchronized processes that are experienced and expressed in different response systems, including experiential, behavioral and physiological responses ([Scherer, 2005](#)). Although the concept of emotion varies in different fields of study, basic emotions are characterized as having an independent neural system and should be experienced separately from one another to some extent: they are not only considered as a subjective experience that manifests biological expression, but also as an expression that is universally recognizable ([Ekman, 1992](#); [Izard, 1992](#)). The following states or reactions are often cited as the basic emotions: interest–excitement, joy–happiness, surprise–startle, distress–anguish, anger–hate, fear–terror and disgust ([Tomkins, 1963](#); [Izard, 1977](#)). Each emotion can exist at varying degrees of intensity or levels of arousal. Some of these emotions, particularly distress and comfort, are closely linked to attachment.

Distress is defined here as a basic emotion, in reaction to aversive, unpleasant, uncomfortable and upsetting experiences ([Monin et al., 2010](#); [Brodbeck et al., 2014](#)). It is an emotional response to stimuli that increase the likelihood of danger, as well as attachment-related threats, usually linked to various negative feelings: sadness, abandonment and loss ([Mikulincer and Shaver, 2007b](#)). The purpose of distress is to call attention to a constant stimulus, to indicate to the self and others that all is not well and that some action is required ([Tomkins, 1963](#)). Distress elicits the activation of attachment (i.e., support-seeking) and usually disappears when a sense of security is reached ([Sroufe and Waters, 1977](#)). In the parent–adolescent relationship, high levels of abandonment and exclusion emerged as predictors of emotional distress ([Kenny et al., 2013](#)) that undermines the capacity to effectively regulate oneself and gives rise to self-destructive tendencies ([Dianne et al., 2001](#)).

Comfort is also considered here as an attachment-related emotion. Although it is a synonym of consolation, an emotion that serves to alleviate grief and sorrow ([Kolcaba and Kolcaba, 1991](#)); it has been mainly described in the context of attachment. This emotion is felt when proximity with a supportive parent or partner and/or emotional support have been attained ([Ainsworth, 1991](#)). It creates a sense of safety and inspires interpersonal connection to others. The extent to which one feels comfortable being close to and depending upon others in times of need is a key feature of attachment security, serving crucial evolutionary functions by its role in regulating emotion and satisfying attachment needs ([Bowlby, 1977, 1982](#)). "Only when relief is attained and a sense of attachment security is restored can the individual deploy attention and energy to other behavioral systems and engage in non-attachment activities." ([Mikulincer and Shaver, 2007a, p.16](#)). We chose to add the third category of joy–complicity because, in the context of interpersonal relationships, we were interested of the feeling of shared joy, in particular in adolescence, when interactions with peers have begun to provide important sources of complicity and intimacy ([Allen and Land, 1999](#)). Joy is defined as a basic emotion of great pleasure and happiness ([Plutchik, 1980](#); [Ekman et al., 1982](#); [Shaver et al., 1987](#)). Adolescents move away from parental authority and increasingly turn to peers as a source of support and companionship ([McElhane et al., 2009](#)). This also leads them to find new attachment figures among their peers; thus finding satisfaction in sharing the emotion of complicity. Here, complicity is related to reciprocity, intimacy and emotional support ([Werebe, 1987](#)). In support of attachment theory, complicity is not per se an attachment-related emotion, but is mediated by attachment security, especially in adolescence. The quality of child–parent attachment security influences the nature and quality of friendship ([Belsky and Cassidy, 1994](#); [Stocker, 1994](#)).

The BAPS-Ado contains four pre-defined categories of emotional stimuli: distress, comfort, joy–complicity and neutral. Pictures of

distress and comfort solicit the most attachment-relevant emotions. The category of joy-complicity contains scenes displaying close relationships among friends, a parent and/or a teenager, and also solicits the emotions linked to attachment, but to a lesser degree than comfort. The category of neutral pictures contains mostly silhouettes of people with neutral facial expressions and without close interaction. This category, although intentionally deprived of emotional character, ensures human presence, unlike other databases containing neutral inanimate pictures, mainly with objects and landscapes.

We hypothesize that valence, arousal, and dominance scores will be different for each category: positive, negative, and neutral. We suppose that unpleasant valence, great arousal and low dominance ratings will be attributed to negative pictures. Positive pictures should be characterized by more pleasant valence, even greater arousal and higher dominance, in comparison to negative and neutral pictures. We also hypothesize that pictures of distress would trigger the emotion of distress more than other negative emotions (hate and horror), and that pictures of comfort would elicit the emotion of comfort more than other positive emotions (joy and complicity), whereas pictures of joy-complicity would elicit emotions of both joy and complicity, without the emotion of comfort.

2. Methods

2.1. Stimuli

The authors preselected 113 pictures, representing different emotional categories (distress, comfort, complicity and neutral), collected from free online picture databases and the IAPS database¹. Five naïve judges (psychologists, child psychiatrists from the university hospital, and scientists from the laboratory of neurosciences (2 men, mean age: 35 ± 10 and 3 women, mean age: 39 ± 7.33) independently assigned each picture to one of the four categories. The criteria of selection used in this phase were based on socio-emotional context and hedonic valence. The first category of pictures included scenes of distress (e.g., faces expressing sadness, anguish, or scenes of loss and separation). The second category integrated comfort-related scenarios (e.g., a parent comforting an infant or an adolescent after an episode of distress). The third contained pictures of complicity (e.g., joyful moments: parent/child interaction, and partner or peer interactions). The fourth category contained neutral scenes (e.g., persons walking along a street, or in the subway). Pictures of low quality, and those representing “hate” or “horror”, were removed, and the remaining 103 photographs, in either landscape or portrait format, were centered, and then cropped or resized (by placing smaller pictures on a black background), to obtain uniform dimensions of either 640×480 or 480×640 pixels. Texts and comments were removed to leave only the pictorial aspects. Each picture represents a scene with the participation of people of different ages and gender. Levels of color saturation (50%) and lightness (50%) were adjusted with Adobe Photoshop (Adobe® Photoshop® Elements 6.0, Los Angeles, USA). According to the common law (for the US: U.S.C. Title 17, chapter 1, § 107; for France: § 4 of subsection 13 of the LDA), such materials can be used for non-commercial research purposes. The BAPS-Ado is freely accessible to the scientific community for non-commercial use upon request, at <http://neurosciences.univ-fcomte.fr>. Examples of pictures from each category are depicted in Fig. 1.

2.2. Participants

One hundred and forty Caucasian participants, male (34.29%, mean age = 13.68, S.D. = 1.11) and female (65.71%, mean age = 14.37, S.D. = 1.56), aged from 13 to 18 years, with French as the native language, were recruited from secondary schools in Besançon, France. Exclusion criteria were severe neurological or psychiatric disorders, age < 13 and > 18 years. The participants reported normal or corrected-to-normal vision and were naïve regarding the emotional pictures. Written informed consent was obtained from each participant and their parents. No compensation was given for participation. The ethics committee validated the protocol. This study complied with the principles in the Declaration of Helsinki.

¹ Pictures from the IAPS database were numbers 2250, 2530, 2900, 2800, 2095, 2205 and 9530.

2.3. Validation procedure

For rating, the pictures were divided into two subsets, consisting of 51 or 52 pictures, randomly assigned to two groups of 70 adolescents. Using separated groups of raters for subsets of stimuli is a procedure that has been used in previous studies (Langner et al., 2011), to shorten the rating procedure and to avoid cognitive overload for raters. Pictures were individually projected on computer monitors in front of participants, at a viewing distance of about 50 cm, in a classroom with ambient light. From 8 to 25 adolescents were present simultaneously in the room. Task instructions and a description of each rating scale were displayed on the screen. Each trial started with the presentation of the stimulus alone, displayed against a gray background for 10,000 ms, followed by a gray background presented for 5000 ms.

According to Russell's model, emotions vary along three independent, bipolar dimensions (Russell and Carroll, 1999): affective valence, arousal and dominance (Russell and Mehrabian, 1977; Russell et al., 1989). To assess the attachment-related emotions, a computerized version of the Self-Assessment Manikin (SAM, Lang, 1980) was used, allowing participants to rate their subjective experience (Bradley and Lang, 1994). In our study, the continuous nine-point scale rated valence from positive to negative (1 = “happy”, 9 = “unhappy”) and arousal from high to low (1 = “aroused”, 9 = “calm”), whereas dominance was rated from low to high (1 = “dominated”, 9 = “dominating”).

The distinction between positive and negative emotions is fundamental in subjective experience (Scherer, 2005). In order to identify the different types of emotions, and to minimize the number of misinterpreted or ambiguously classified pictures, participants had to choose between three possible labels: “negative”, “neutral”, or “positive”. We calculated the percentage of use of each label, for each picture, and then averaged this for all pictures in a given category (distress, comfort, joy-complicity, or neutral), to obtain the “per category labeling percentage”.

To distinguish the attachment-related emotions, three bipolar 9-point scales (ranging from 0 = not at all, to 9 = very much) were used to further categorize the “negative” label, for distress, hate and horror, while the “positive” label was similarly evaluated, for comfort, complicity and joy. Choosing the “neutral” label simply led to the display of the next picture (Appendix 1, Decision tree). The experiment lasted approximately 45 min. To limit the effects of sensitization (the effect of repetitive exposure to pictures of the same affective valence), the viewing order was randomized (Bradley and Lang, 1994). Visual tasks were programmed using Inquisit 3[®] software (Millisecond Software, Version 3.0.3.2, Seattle, WA).

2.4. Selection and categorization of pictures

To eliminate any ambiguous pictures from the four predetermined categories, only those pictures within the mean scores for SAM valence (1–9, happy to unhappy) and either plus or minus twice the standard deviation (± 2 S.D.) were retained in the database. Outlying scores for “distress” were ≤ 6.03 , for “comfort” ≥ 5.68 , while outlying scores for “joy-complicity” were ≥ 3.52 . An additional selection was, based on the mean of each emotion assessment: outlying scores for “distress” were ≤ 5.98 , for “comfort” were ≤ 6.04 and for “joy-complicity” ≤ 6.52 . Outlier pictures in the “neutral” category scored ≤ 4.43 ; $5.54 \geq$. After removing a total of 10 outliers, 93 pictures remained (n distress = 22, n complicity = 23, n comfort = 25, and n neutral = 23). The Supplementary material 1 Table S1 includes a list of the ratings for all 93 pictures.

2.5. Statistics

We conducted parametric one-way ANOVAs, followed by Bonferroni post-hoc tests, to compare the level of arousal ratings for each category: “comfort”, “complicity”, “distress” and “neutral”. The Kruskal–Wallis non-parametric test was used for valence and dominance, as Bartlett's test indicated that equality of variance for these two dimensions was violated. Paired *t*-Tests were performed to compare emotion ratings for each category. Pearson's Chi-squared test was performed to determine the difference between per category labeling percentages. A threshold of 5% was set for the tests. Ratings were analyzed with STATA/SE (Stata[®], Texas, USA).

3. Results

3.1. Set comparison

In order to verify the homogeneity of the database, we performed a two-tailed *t*-Test for the valence, arousal and dominance of the two subsets. No *P*-value was inferior to 0.59. The

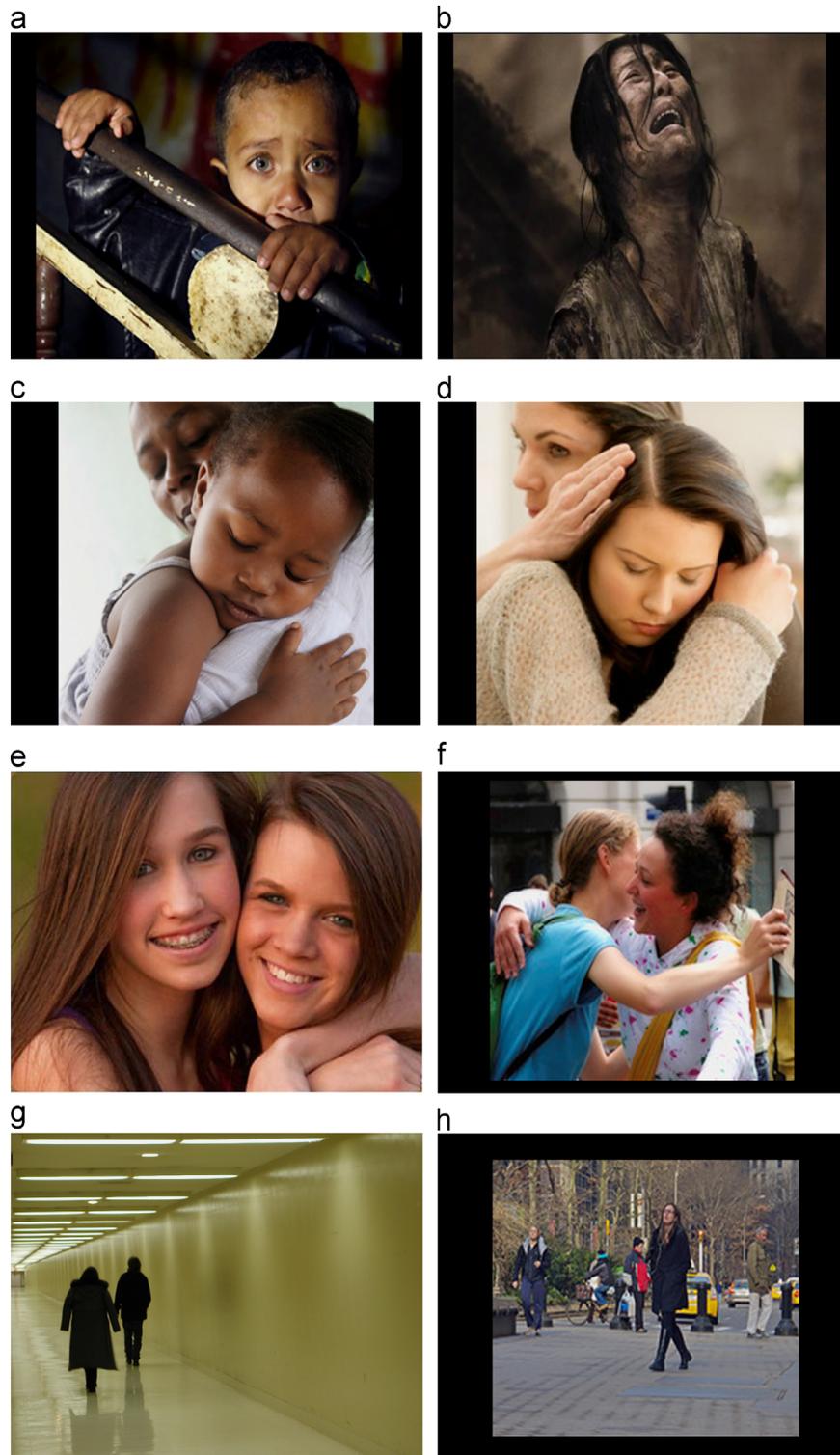


Fig. 1. Examples of pictures of (a, b) “distress” #30, #31; (c, d) “comfort” #90, #87; (e, f) “joy-complicity” #13, #5 and (g, h) and “neutral” photographs #61, #49.

ratings from the two subsets were considered as one database with comparable ratings (Supplementary material 2 [Table S2](#)).

3.2. Dimensional ratings

The SAM ratings for each individual photograph are presented in the Supplementary material 1 [Table S1](#) . Descriptive statistics for the SAM ratings are given in [Table 1](#) .

3.2.1. Valence

The nonparametric Kruskal–Wallis test showed a picture category effect for valence $H(3, 92)=80.510$, $\eta p^2=0.92$, $P<0.001$ ([Table 1](#)). Post-hoc Bonferroni comparisons indicated that valence rating was significantly higher for the category of “distress” than for other categories ($P<0.001$). The pictures of “comfort” and “joy-complicity” did not significantly differ from each other ($P=0.018$). “Neutral” pictures significantly attracted lower ratings ($P<0.001$).

3.2.2. Arousal

A one-way ANOVA revealed a significant effect for arousal $F(3, 92)=26.78$, $P < 0.001$, $\eta^2=0.47$ (Table 1). Post-hoc Bonferroni comparisons indicated that arousal category ratings differed significantly from each other, with the exception of “distress” and “joy-complicity” ($P=1.000$), which were both highly arousing. Pictures of “comfort” elicited moderate arousal ratings ($P < 0.001$). The “neutral” category elicited less arousal ($P < 0.001$) than the other categories.

3.2.3. Dominance

Picture content was significantly related to dominance ratings (Table 1). The Kruskal–Wallis test showed a picture category effect for dominance $H(3, 92)=58.86$, $\eta^2=0.59$, $P < 0.001$. Post-hoc Bonferroni comparisons showed that pictures of “distress” were associated with significantly low dominance (participants felt weak in response to distress) ($P < 0.001$). There was no significant difference ($P=0.263$) between the positive categories (“comfort” and “joy-complicity”), which both elicited a moderate level of dominance. In contrast, the “neutral” category elicited significantly high dominance ($P < 0.001$) (participants felt strong in response to “neutral” pictures), compared to the other categories.

3.3. Slide distribution across affective areas

A scatter plot (Fig. 2) was drawn in accordance with the valence and arousal means for each picture. The distribution pattern resembles the “boomerang-shaped” relationship found in the IAPS database (Bradley et al., 2001; Libkuman et al., 2007). The picture-affective distribution showed a curvilinear U-shaped relationship between valence and arousal. The majority of the pictures of

Table 1
Summary statistic mean and standard deviation (S.D.) of valence, arousal and dominance, assessed by the SAM scale, for each picture category.

	Distress (N=22) Mean (S.D.)	Comfort (N=25) Mean (S.D.)	Joy-complicity (N=23) Mean (S.D.)	Neutral (N=23) Mean (S.D.)
Valence	7.68 (0.62)***	3.49 (0.79)###	2.71 (0.31)###	5.05 (0.21)***
Arousal	5.67 (0.46)†††	6.27 (0.58)***	5.75 (0.56)†††	6.86 (0.43)***
Dominance	4.67 (0.47)***	5.18 (0.36)###	5.28 (0.19)###	5.79 (0.22)***

1=Happy, 9=unhappy, 1=aroused, 9=calm, 1=dominated, and 9=dominating.

*** $P < 0.001$, with all other groups.

††† $P < 0.001$ with comfort, neutral.

$P < 0.001$ with distress, neutral.

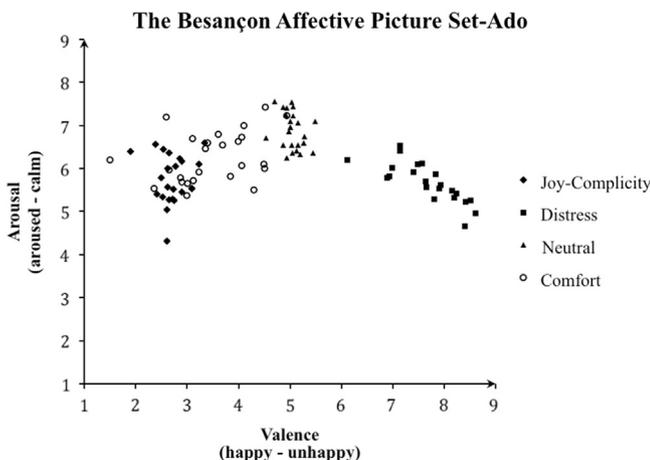


Fig. 2. Distribution of pictures from the BAPS, plotted in two-dimensional affective space determined by the mean ratings for valence (x-axis) and arousal (y-axis) for each stimulus. Each dot represents the rating for a particular image.

“distress”, evaluated as more unpleasant and arousing, were distributed within the moderately arousing negative-affective area. In contrast, the pictures of “comfort” were dispersed between the moderately arousing neutral and positive areas. Only a small number of these pictures overlapped in the positive moderately calm area of pictures of “joy-complicity”. Generally, the pictures of “joy-complicity”, rated as more pleasant and more arousing, were distributed in the area of moderately arousing positive affect. “Neutral” pictures, characterized by low arousal and intermediate valence, were over-represented in the affectively neutral area.

3.4. Per category labeling percentages

Pearson’s $\chi^2(6)=5500$, $P < 0.001$ showed that results for labeling within each category were significantly different. For pictures of “distress”, participants labeled 81.32% negative, 16.45% neutral and 2.23% positive. For pictures of “comfort”, 68.20% were labeled positive, 25.36% neutral and only 6.44% negative. For pictures of “joy-complicity”, 76.52% were labeled positive, 22.78% neutral and only 1.13% negative. For “neutral” pictures, 86.86% were labeled neutral, 7.65% negative and only 5.47% positive.

3.5. Summary statistics and comparisons for emotion ratings

Emotion ratings for each individual picture in the database are presented in the Supplementary material 1 Table S1.

The paired, two-tailed, t tests of emotion ratings showed that the pictures of “distress” elicited significantly more distress than hate or horror ($P < 0.001$). The pictures of “comfort” induced significantly more comfort than joy or complicity ($P < 0.001$). The pictures of “joy-complicity” presented similar levels ($P=0.118$) of joy and complicity (Table 2).

4. Discussion

Attachment theory is viewed as a valid framework for explaining variations in mental health, emotion regulation, and interpersonal relations. From early childhood to adulthood, the main function of the attachment system is to maintain proximity to significant others in times of stress or, in other words, to regulate support-seeking behavior (Bowlby, 1969, 1982). Repeated interactions with attachment figures are then internalized into representations of attachment, facilitating the formation of a secure base, a sense of perceived security (Sroufe and Waters, 1977; Ainsworth et al., 1978). This sense comes from the experience of relief and comfort (Waters et al., 1998) provided by an attachment figure after the child had felt threatened by internal or external stimuli.

Table 2

Comparison matrix t Test, means and standard deviations (S.D.) of self-reported emotional experience, assessed using continuous scales for each picture category. N.B.

Picture category	Emotion	Mean (S.D.)	t Test	d	P
Distress	Distress	7.28 (1.43)	–	–	–
	Hate	4.64 (1.91)	$t(139)=15.91$	1.765	< 0.001
	Horror	5.48 (1.77)	$t(139)=12.99$	1.202	< 0.001
Comfort	Complicity	6.67 (1.86)	$t(136)^a=3.45$	0.272	< 0.001
	Comfort	7.12 (1.64)	–	–	–
	Joy	6.51 (1.59)	$t(136)^a=4.88$	0.371	< 0.001
Joy-complicity	Complicity	7.14 (1.67)	–	–	–
	Comfort	6.01 (1.84)	$t(139)=6.22$	0.613	< 0.001
	Joy	7.32 (1.68)	$t(139)=1.57$	0.712	0.118

^a indicates that three subjects considered the pictures of comfort as neutral. $P < 0.001$; two-tailed.

Distress is one of the main attachment-related threats. Attachment research has widely focused on how these representations have influenced emotions, cognitions and behaviors in interpersonal situations. Exploring aspects of complicity is relevant, due to the complexity of the attachment system in adolescence, as it evolves into multiple new forms and long-term peer relationships, including “the increasing mutual capacity to provide comfort in relationships” (Allen, 2008a, p. 431).

There is a need to develop sophisticated and specific approaches to assessing attachment-related emotion in adolescence, validated among that population. We propose BAPS-Ado, a new attachment-related picture database that yields pictures eliciting emotional states of distress, comfort, joy-complicity, and a neutral state. One hundred and forty adolescents validated the pictures, according to three dimensions underlying affect: the pleasantness of a stimulus (valence), the intensity of emotion provoked by a stimulus (arousal), and the degree of control exerted by a stimulus (dominance), evaluated by The Self-Assessment Manikin (SAM, Lang, 1980). They also assessed the level of several emotions: distress, hate, horror, comfort, joy and complicity, using 9-point scales. The current database provides a set of 93 pictures that were found to effectively cover the affective space (Fig. 2), based on the multidimensional model of emotion.

4.1. Self-reported affect

It is widely accepted that valence and arousal are two core affective dimensions of emotion. This two-dimensional structure is commonly used as a tool for categorizing the affective quality of emotion (Lang et al., 1993). The first rated dimension was affective valence. Valence contrasts pleasant and unpleasant, intrinsic, affective states (Russell and Mehrabian, 1977). As expected, there was a significant difference between ratings of SAM valences. The pictures of “distress” were rated more unpleasant. Both positive categories (“comfort” and “joy-complicity”) were estimated to be more pleasant than either the “neutral” category or “distress”. Consistently with our expectations, the neutrally experienced pictures were characterized by an intermediate valence that approached the midpoint.

The dimension of arousal distinguishes an aroused state from a calm state, including emotions in a developmental system that helps the organism to avoid aversive stimuli (Bradley and Lang, 2000). Arousal is related to the vigor of the behavioral disposition, which can range from a level of extreme emergency to that of calm behavior (Russell and Mehrabian, 1977; Russell et al., 1989; Russell and Carroll, 1999). In our sample, adolescents felt aroused when looking at pictures of “distress”, or “joy-complicity”. They felt relaxed when seeing pictures of “comfort”, or “neutral” pictures: in general, the means of arousal of positive and negative pictures in the BAPS-Ado were mostly between 5 and 7 points on the 9-point SAM scale, but slightly higher for pictures of “distress”. These results are similar to previous research indicating that moderate arousal could be produced by negative pictures, depicting intention to harm, generating anger and fear, but also by pictures representing frustration of goals, including sadness (Javela et al., 2008). Only extremely negative (e.g., images of death) or positive stimuli (e.g., erotic pictures) can provoke a high level of arousal (Walter et al., 2008).

The judgment of dominance was defined as the degree to which the observer feels in control of emotions induced by a given scene (Bradley and Lang, 1994). As estimated, some adolescents felt less in control of their emotions when viewing pictures of “distress”, compared to “comfort” or “joy-complicity”, or to “neutral” pictures. These adolescents felt dominated by negatively charged pictures, showing upset and abandoned children for the most part. Some researchers agree that this dimension is

necessary to disambiguate negative emotions mainly pride, anger and contempt from sadness, shame and despair (Fontaine et al., 2007). Others do not accept this dimension because of its statistical instability (Bradley and Lang, 1994; Colden et al., 2008).

4.2. Subjective emotional ratings

Concerning emotional states, our aim was to discriminate attachment-related emotions (distress and comfort) from other emotions. The participants completed rating scales to evaluate the level of emotions experienced: distress, hate and horror, for the negative pictures: comfort, complicity and joy, for the positive pictures.

As we expected, the preselected pictures of “distress” were clearly judged as distress rather than as hate or horror. Following attachment theory, the abandonment, rejection and personal loss displayed in these pictures are supposed to elicit distress and activate the attachment system and support-seeking (Bowlby, 1982). Research indicates that distress activates the attachment system, with the relative coherence of working models influencing the perceptions of others during distressing events (Kobak and Sceery, 1988). Apart from distress, these pictures were judged, to a much lower degree, as emotions of hate and horror. Hate, considered here as a profound, persisting, intense emotion, expressing animosity, anger, and hostility (Navarro et al., 2013), does not activate attachment. The same applies to horror, meaning unpleasant emotion linked to terror and revulsion. This emotion, usually occurring after something scary is experienced, is more related to being shocked or scared than distressed.

Concerning comfort, we expected that pictures of “comfort” would generate pleasant sensations of security (Ainsworth, 1985), which would be different from other positive emotions, such as joy and complicity. Indeed, the majority of pictures of “comfort” elicited more comfort than joy and complicity. Nevertheless, some adolescents rated them as negative pictures more often than expected. This could be due to the ambiguity of these pictures, which were selected to show that the comforted person had stopped crying or sobbing upon being hugged. It is possible that some pictures display a person not yet fully comforted and that some adolescents therefore experienced mixed emotions about them, either simultaneously or sequentially.

Regarding the pictures of “joy-complicity”, they were rated as high for complicity as for joy, and elicited more joy and complicity than comfort. These pictures depict scenes of spontaneous interactions and close relationships between two persons in a variety of social activities. They display blended emotions associated with feelings of great delight or joy related to something good or satisfying (Frank et al., 1993). They depict primarily confidence, cooperative behavior and support from peers, and are also linked to security of attachment, but to a lower degree than comfort.

Discrimination of emotionally neutral pictures was unambiguous. Generally, the majority of neutral pictures were identified as such. Nevertheless, we did not expect the relatively high rating of neutral in the different categories of “distress” (17%), “comfort” (26%) and “joy-complicity” (23%). This result could be due to a defensive cognitive process (Allen and Manning, 2007), but also to the validation procedure. Some participants rapidly understood that this label led to the next image directly, without presentation of emotional scales to rate; thus allowing them to complete the assessment more quickly. Despite this drawback, our results are sufficiently robust to validate the database.

4.3. Limitations and future directions

The BAPS-Ado is a newly developed database, and our sample size was relatively modest compared to the GAPED (Dan-Glauser and

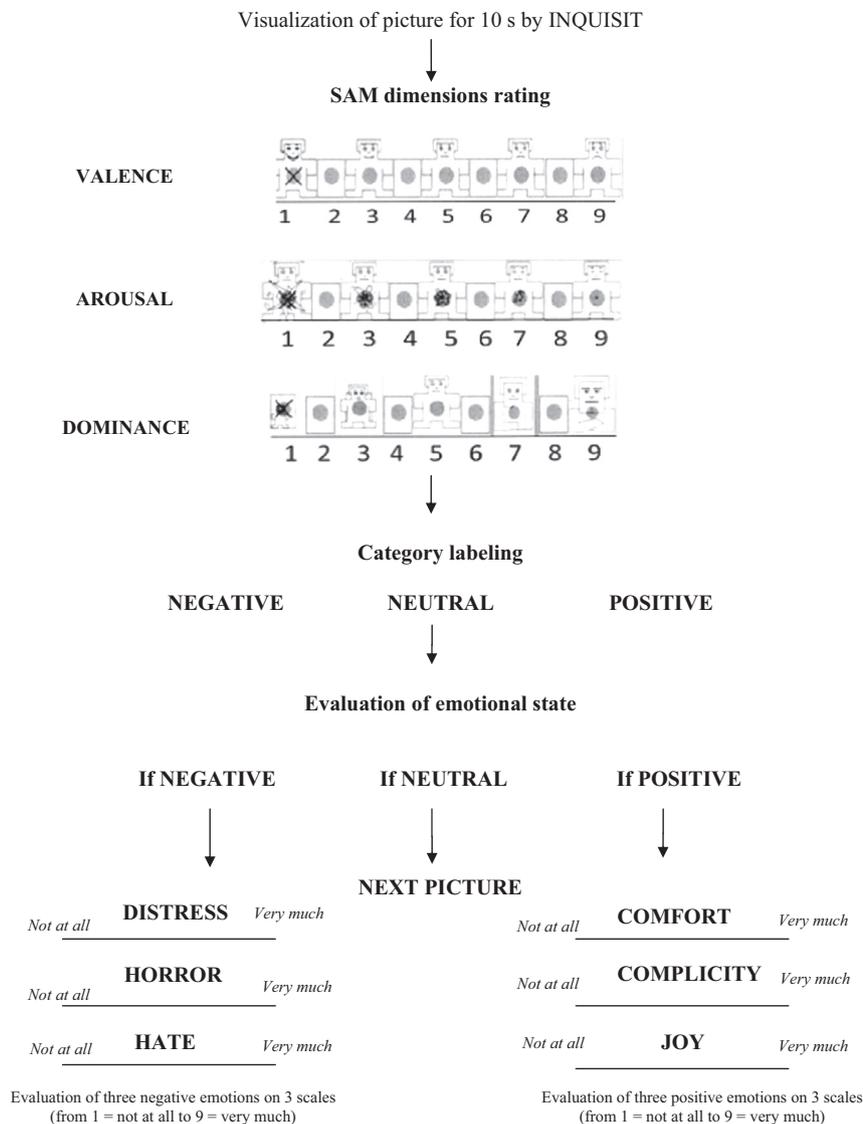


Fig. A1

Scherer, 2011) or the IAPS (Lang et al., 2008). However, we are currently adding new attachment-related pictures and extending validation to adult subjects. As the emotion-eliciting process may be influenced by age, especially for valence ratings (Grühn et al., 2008), further replication is needed to assess subjective emotional experience for other age groups. During the procedure, the “dominance” dimension of the SAM was difficult to understand for some of the adolescents, whatever their age, despite the use of stick figure pictograms, so these results should be taken with caution. The per category labeling categorization procedure leading to emotional scales does not allow for the investigation of the “full” spectrum of emotions induced by the pictures, especially those with “mixed emotions”. Allowing a “mixed” label (to assess negative and positive emotions simultaneously) could overcome this obstacle. Here, the goal of the database was to filter and discriminate the nature of emotions using a single categorical label.

Nevertheless, this study offers many potential advantages. In terms of the procedure, pairing “neutral” with the emotional categories rated has the advantage of keeping a comparison term as a constant anchor-point to evaluate a given emotional expression. The BAPS-Ado offers a combination of ratings on both affective dimensions and attachment-related emotions. It could

be interesting to assess the influence of the different styles of attachment on the perception of these emotions. Priming techniques (i.e., supraliminal exposure to attachment-related and attachment-unrelated primes, Mikulincer et al., 2001, 2005) could also be used to investigate the impact of contextual activation of the secure base schema. The BAPS-Ado supplies material for studies assessing emotional physiological reactions and brain activities.

5. Conclusions

The BAPS-Ado was created to contribute to the growing interest in the regulation of emotions, especially those linked to attachment, in the field of psychology and psychiatry. The BAPS-Ado focuses on attachment-related emotions, like distress and comfort, and evaluates a larger spectrum of emotional states, which have rarely been studied in the context of adolescence, until now. Researchers should considerably benefit from this new collection of visual stimuli, complementary to other databases, and will now be able to select pre-rated attachment-related pictures from the BAPS-Ado database.

Author contribution

Conceived and designed the experiment: SN, LV-C, JM, NN and EL.

Performed the experiment: MS, NN and LG. Analyzed the data: GT, MS, NN. Contributed to the writing of the manuscript: MS, LV-C, JM and EL.

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Appendix A. Decision tree

See Fig. A1 here.

Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.psychres.2015.04.055>.

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