**Abstract**

Patterns of simultaneous experiences of mixed emotion have been found in adulthood using analogue emotion scales (AES) that measure subjective intensity and duration of two emotions in one graph. Children report simultaneous emotions increasingly between 5 and 7 years of age. These reports may underestimate the type of simultaneous experiences. This research piloted an extended interview and AES to assess subjective mixed emotion types in childhood. One hundred and eighty children (91 girls, 89 boys) between 5 years 2 months and 7 years 3 months (*M*= 6 years 3 months) were allocated to two conditions (self: *n*= 90, other: *n*= 90), hearing a vignette describing a mixed emotion event occurring either to another child or to themselves. Loglinear analysis of reported and graphed responses showed simple, sequential, prevalence, inverse, and highly simultaneous emotion experiences. Younger children reported more single and sequential experiences. Older children reported and graphed more simultaneous experiences. Mixed emotion varied by measure type with more prevalence experiences graphed than reported and more inverse experiences reported than graphed. The results indicate the potential for the utility of the adapted AES for use with children.

Children’s understanding of mixed emotion experiences increases between the ages of 4 and 12 years of age (Pons & Harris, 2004), with understanding of the experience in others preceding that in oneself (Heubeck, et al., 2015). The question of how children experience sequential and simultaneous mixed emotion remains relatively unexplored with scant evidence suggesting that children report that feelings such as happiness and sadness can happen at the same time or one after another (Burkitt & Sheppard, 2014). Patterns of sequential and simultaneous mixed emotion experiences have been found in adulthood (Oceja & Carrera, 2009) using an analogue emotion scale (AES) that measures the intensity and duration of two mixed valence emotions over time on the same graph. The AES does not rely on verbal reports and is argued to give a more accurate measure of the intensity and duration of subjective experiences of mixed emotion than rating scales and verbal reports (Carrera & Oceja, 2007; Oceja & Carrera, 2009). The present study therefore examined children’s subjective mixed emotion experiences using an adapted AES to assess the presence of types of mixed emotion experiences found in adulthood and to compare the use of verbal reports or the AES to measure these experiences

**Mixed emotion in adulthood**

Current theories concerning adult populations suggest that mixed emotion can be simultaneously experienced in different ways (Berrios, Totterdell, & Kellett, 2015; Larsen & McGraw, 2014). Research focussing on the subjective experience of mixed emotion, defined as the co-activation of two emotions typically of opposite valence (Larsen, McGraw, & Cacioppo, 2001), primarily seeks to understand the types of blended and mixed experiences in terms of happiness and sadness in adulthood. On the one hand, authors suggest that specific contrasting emotions represent opposite dimensions on a bipolar scale and therefore cannot be experienced simultaneously (Green, Goldman, & Salovey, 1993). The Circumplex model (Russell & Carroll, 1999) contends that only opposite emotions such as happiness and sadness are mutually exclusive and that high arousal emotions can co-exist, for example, when someone feels stressed and excited. Similarly, Watson and Tellegen (1985) argued that high levels of positive and negative activation states can be independent as experiences, implying that intense positive and negative activation can co-occur.

Alternatively, an increasingly supported view is that emotions with opposite valence can be represented on independent dimensions which can be experienced simultaneously (e.g., Cacioppo, Gardner, & Berntson, 1999; Larsen et al., 2001). The Evaluative Space Model (ESM) posits that the affect system is defined by different operating characteristics for positive and negative emotion that can lead to different behaviours, and are activated differently within the nervous system (Norris, Gollan, Bernston & Cacioppo, 2010). This model indicates that the operation of positive and negative substrates of valence are experientially separable (Cacioppo & Berntson, 1994; Cacioppo, Larsen, Smith, & Berntson, 2004). Larsen and McGraw argued that this contention implies, unlike the circumplex model, that any pair of opposite valence emotions can co-occur (Larsen, McGraw, & Cacioppo, 2001). In reviewing a range of research, Larsen and McGraw (2014) concluded that there is sound evidence to show that emotions with opposite valence – in particular, happiness and sadness – can be experienced simultaneously.

In support and extension of their conclusion, Berrios et al. (2015) reviewed 63 studies which varied in the emotional pairs and conceptualisation of underlying models of mixed emotion, namely discrete or dimensional, and concluded that mixed emotion experiences occur regardless of the emotion pairs and dimensional or discrete nature of the foundational conceptualisation of the studies. They suggested that the affective system could be flexible enough to permit multiple activation patterns of mixed emotion ranging from bipolar responses, blended responses where similar valence emotions are activated, and different patterns of mixed opposite valence emotions. The mixed valence experiences could even be new feelings and not necessarily a mix of the initial emotion pairs (Henderson & Norris, 2013). Berrios et al. suggested that a pressing question is ascertaining whether, in line with the ESM, the experience constitutes a genuine co-activation of opposite valence emotions or a rapid alternating succession between them. This question also remains unexplored in childhood.

**Measures of mixed emotion over time**

Key demonstrations of the existence of different patterns of mixed emotion experiences come from Carrera and Oceja’s (2007; 2009) sequence of studies where they used affect rating scales alongside their original and extended AES to capture the simultaneous and sequential experience of mixed emotion. The AES was designed to measure subjective emotional experiences throughout the duration of the experience and therefore permit discrimination between two sequential or simultaneous emotions of opposite valence. The AES requires participants to draw two lines corresponding to happiness and sadness on the same graph noting the duration and occurrence of each emotion separately.

Carrera and Oceja (2007) assessed subjective experiences of happiness and sadness using affect ratings and AES responses about a recalled event of mixed happiness and sadness, an elicited event, and after participants viewed a film where the sequencing of single and mixed emotion was controlled. They found that adults’ AES responses could be categorised as simultaneous, sequential, parallel and combined; additionally, fewer mixed emotions were evident using the AES than the affect rating scales. The experience types were extended with closer examination of the nature of the simultaneous category (Oceja & Carrera, 2009) across a series of studies where emotion inducing stimuli ranged from recalled personal events, verbal accounts, videos, and photographs. They showed that the simultaneous experience was moderated by the intensity of the emotional experience and proposed refined categories. These were firstly, the sequential category, where one emotion is replaced by the second (e.g., when someone feels happy and then sad about an event, perhaps happy when a friend visits and then sad when they hear their sad news). Secondly, they identified the prevalence category, where both emotions last throughout an experience with one emotion at high intensity and the other of low intensity throughout (e.g., where someone is somewhat excited and very scared throughout a thunderstorm). Thirdly, the inverse category, where one emotion increases and the other decreases in intensity, was found. Someone could be feeling increasingly confident and decreasingly nervous during a positive job interview. Finally, the highly simultaneous category was identified, where the emotions endure in similar moderate or high intensity levels for part or all of the experience. For example, a child could feel equally very happy and sad about moving to a new school. The capacity of the AES to capture the temporal nature of the experience and not rely solely on verbal report offers great potential for extending understanding of the development of mixed emotion experience in childhood.

**Mixed emotion recognition and understanding in childhood**

The question of the nature of the subjective experience of mixed emotion, especially for types of simultaneous experiences, across childhood to adulthood remains relatively unexplored. However, findings are emerging that suggest a developmental separation of children’s recognition of the experience in others and in themselves (Smith, Glass, & Fireman, 2015). Children as young as 5 years demonstrate mixed emotion recognition by matching mixed emotion images to vignettes (Kestenbaum & Gelman, 1995), and brief training can facilitate 6- to 7-year-olds’ mixed emotion recognition (Peng, Johnson, Pollock, Glasspool, & Hams, 1992). Younger children of 3 years of age appear to have difficulty recognising mixed emotion in themselves compared to 5-year-olds (Smith, Glass & Fireman, 2015). Children begin to recognise mixed emotion in others before they recognise it in themselves (Burkitt & Sheppard, 2104; Callaghan, 1999; Larsen, To, & Fireman, 2007). Indeed, Smith et al. (2015) found that 3 year olds were able to report mixed emotion in a fictional character. This recognition in others and within themselves generally increases throughout early to mid-childhood typically between the ages of 7 and 12 years (Donaldson & Westerman, 1986; Harter & Buddin, 1987; Larsen et al., 2007; Wintre &Vallance, 1994). An understanding of the possibility of experiencing mixed emotion due to increasingly complex emotional situations also develops across the age range (Larsen et al., 2007).

Pons, Harris and de Rosnay (2004) developed a model of emotion understanding about the nature, causes and regulation of emotion in relation to nine discrete components of emotion understanding. They proposed that emotion understanding improves between the ages of 3 and 11 years through three phases where progress to the next phase is conditional on successful comprehension in the preceding phase. In phase one, usually around 5 years of age, children can identify expressions, understand cues that remind them of an emotion and understand primarily external causes of why an emotion is activated. By the second phase, at approximately 7 years of age, children can appreciate the difference between felt and expressed feelings and can recognise influences of beliefs and desires on emotional experiences. The third more reflective phase, emerging between 9 to 11 years of age, involves understanding more complex casual processes of single and mixed emotions, such as the possibility that different perspectives regarding an event can cause different emotional responses. They found that three correlated components emerge in each phase with hierarchical correlations between the successive phases. Mixed emotion understanding is one of nine components of understanding in this model (the other components being recognition, external causation, desire, belief, reminder, regulation, hiding, and morality). They found that children around the age of 8 to 9 years understand that individuals can have several or contradictory ambivalent emotions regarding a scenario about another child, for example who is delighted to receive a bicycle yet concerned that they might injure themselves. This age range is slightly older for mixed emotion understanding than in related research, but the authors acknowledge that the scenarios testing mixed emotion were brief and focussed on one set of contradictory emotions.

Pons and Harris (2000) developed a Test of Emotion Comprehension which has been validated cross culturally with some variation in the precise ages where children proceed through the three phases. For example, Rocha et al. (2015) found support for the hierarchical structure between the nine components yet a quicker progression through Pons et al.’s (2004) first (3-6 years), second (5-9 years) and third (8-11 years) phases. Rocha et al. (2015) argued that cohort effects or measurement differences may explain their finding that younger children can understand mixed feelings in a protagonist towards one event. The Test of Emotion Comprehension has been validated and standardised across various cultures, for example with Portuguese (Rocha at al., 2015), Italian (Albanese & Molina, 2008; Ornaghi & Grazzini, 2013), Brazilian (Roazzi, Dia, Minervino, Roazzi, & Pons, 2009), Australian (de Rosnay & Harris, 2002), Spanish (Daniel & Gimenez-Dasi, 2012) and Peruvian Quechua (Tenenbaum, Visscher, Pons, & Harris, 2004) children, providing strong evidence that reflective mixed emotion understanding tends to emerge between the ages of 7 and 9 years overall. However, the question remains as to the types of subjective mixed sequential or simultaneous experiences children might recognise around the age of 7 years.

Heubeck, Butcher, Thorneywork and Wood (2015) examined a range of emotion pairs and explored the relationship between children’s recognition of mixed emotion in others and themselves. They questioned previous methods in that perceptual clues in videos used in comparable research (Larsen et al., 2007; Zadjel, Bloom, Fireman, & Larsen, 2013) may have made it easier for children to recognise mixed emotion in others due to emotion cues being portrayed in the videos of others more so than in themselves. Using verbal reports and considering verbal ability, they found significant gains in understanding of mixed emotion between 6 and 12 years of age. They also found that the rate of development depended on the emotion combination in question. For example, happy and sad combinations were understood earlier than the combination of loving and scared. The study also demonstrated that children’s recognition of mixed emotion experiences in themselves emerged more slowly than their recognition in others. These trends applied after verbal ability was controlled for; yet those with higher verbal ability were more able to reflect on the existence and cause of ambivalent experiences. This research, however, did not explore the possibility of a range of types of subjective mixed emotional experiences for children’s own experiences and their recognition of the experiences in others.

In support of the Circumplex and ESM models of the subjective nature of the mixed emotion experience, a small body of research shows that 5- to 6-year-olds report the possibility of feeling co-occurrence of the emotion pairs of sad and happy or angry and calm about the same situation (Harter & Budin, 1987). From the age of 6 years children report that the experience of opposite valence emotion is sequential rather than simultaneous (Burkitt & Sheppard, 2014; Harris, 1983, 1994, 2000; Harter, 1982; Wintre & Vallance, 1994). By 7 to 8 years of age children have been found to report simultaneous mixed emotions (Burkitt & Sheppard, 2014; Burkitt & Watling, 2015).

However, studies attesting to the possibility of different types of mixed emotion experiences in childhood have relied on verbal reports including reflective detailed interviews (Burkitt & Watling, 2015; Donaldson & Westerman, 1986; Heubeck et al., 2015) that may not capture the temporal nature of the experience and that may be quite demanding for young children due to a reliance on verbal ability (Heubeck et al., 2015). These measures rely solely on children’s verbal responses about emotions occurring at the same time or about the possibility of emotions occurring one after another and these measures do not capture any measure of the intensity of a mixed emotion experience. The use of these measures leads to the possibility that the simultaneous or sequential nature of the experience of mixed happiness and sadness is under or overestimated in recent research with children. There is no AES currently available for use within childhood populations.

The emotion interviews in the present study were extended to explore the different types of simultaneous mixed emotion proposed by Oceja and Carrera (2009) to assess patterns of responses across both interview and AES responses thereby assessing if recognition varied as a function of measurement type. Carrera and Oceja (2007) found that in adult populations the AES showed different kinds of simultaneous mixed emotion patterns undetected by interview and rating scales alone.

The main aims of the present study were therefore to assess children’s recognition of single and mixed emotion types using extended interview reports to include Oceja and Carrera’s categories of simultaneous mixed emotion types and an amended AES. The study explored whether children’s recognition and patterns of mixed emotion experience varied with age and varied depending on if they concerned the children’s own experiences or those of others. It was anticipated that the AES would discriminate between simultaneous mixed emotion experiences to a greater extent than verbal reports, that verbal reports of single and mixed emotion would show a different pattern of responses to the AES, that mixed emotion experiences would occur more frequently for older children, and that more mixed emotion experiences would occur in the “other” compared to “self” condition.

**Method**

**Pilot phase**

A pilot phase was conducted to assess children’s comprehension and use of an adapted AES to assess subjective mixed emotion types in childhood (Burkitt & Fotheringham, 2016). Fifty-five children (23 girls, 22 boys) aged between 4 years 2 months - 6 years 2 months (*X*=5 years 3 months; *SD*= 11 months) participated in a pilot phase. These children did not participate in the main study. The children were seen individually in a quiet area of their school within sight of their class teacher. They completed an AES training phase lasting approximately 10 minutes learning how to use two coloured pencils to show different levels of two different kinds of separate fizzy drink consumption over the same period on the same graph. The training phase was intended to familiarise the children with using two different implements to describe two different levels of an entity at different time points on the same graph. The training phase is described fully below for the main study. The children then listened to one of the vignettes used in the main study reported below (see Appendix A) describing events likely to elicit happy, sad, and mixed emotion experiences in an age and gender matched protagonist. They completed the test measure about the protagonists' emotional experiences and were asked to draw how the child felt when thinking about the mixed emotion experiences at the end of the story using a red pencil for happiness and a blue pencil for sadness in the same graph. All children understood how to use the AES graphs (see Appendix B) with only minor prompting required for seven children. Four different AES mixed emotion types were found (sequential, simultaneous, parallel, and combined in order of declining prevalence) highlighting both a broader range of mixed emotion experiences than previously found and attesting to the potential discriminatory utility of the adapted measure.

**Participants**

One hundred and eighty children (91 girls, 89 boys) aged between 5 years 2 months and 7 years 3 months (*X*=6 years 3 months; *SD* = 11 months) participated in the main phase of this research. Power calculations (Dupont & Plummer, 1990; 1998) for the between and within participant design for dichotomous data indicated sufficiency of the sample size for good power (*P*=.9). Children were recruited on the basis of age and consent returns from head teachers, summer group leaders, legal guardians and their own assent across East Sussex, UK. Two age groups were formed (youngest, *n* = 90, 5 years 2 months- 6 years 2 months: oldest, *n* = 90, 6 years 3 months – 7 years 3 months). The children from the two age groups were allocated equally into two conditions based on alternative appearance by gender on the class or summer group attendance lists to hear a single vignette describing events likely to elicit happy, sad, and mixed emotion experiences occurring to either an age and gender matched protagonist or in themselves (other, *n* = 90 and self, *n* = 90). lists.

**Materials**

A single vignette (Burkitt & Sheppard, 2014; Burkitt & Watling, 2015) describing events likely to elicit happy, sad, and mixed emotion experiences in either a gender and age matched protagonist or themselves was used (see Appendix A). The vignette always ended with the protagonist thinking about events that would likely elicit mixed emotions. An AES training graph, and moderated AES graph (see Appendix B) were also used. The mixed emotion interview protocol used in related research to see which emotions the vignettes provoked (Burkitt & Sheppard, 2014; Donaldson & Westerman, 1986; Larsen et al., 2007) was extended to explore potential different kinds of simultaneous mixed emotions in line with Oceja and Carrera’s (2009) types. Emotion presence questions were developed to extend previous emotion presence questions (Burkitt & Watling, 2015; Larsen et al., 2007) to ascertain single, sequential, and simultaneous types (Oceja & Carrera, 2009) of mixed emotion experiences. Children’s verbal ability was measured using the Weschler Intelligence Scale for Children (WISC-IV; Weschler, 2003) vocabulary subscale as resultant scores have been linked to emotion comprehension (Beck, Kumschik, Eid, & Klann-Deliusm 2012; Heubeck et al., 2015).

**Procedure**

**Training phase:** A training phase for the adapted AES (Burkitt & Fotheringham, 2016) was conducted to familiarise children with using two different colours to represent two different events over time. Children looked at pictures of two different gender matched children with either a glass of blue fizzy drink or red fizzy drink. The participants were asked to look at the pictures of a glass with some liquid in it and assess the fullness of the glass. Fullness estimates were graphed at four different points on the same graph using red and blue pencils signifying different points in the day (breakfast time, lunch time, dinner time, bed time). The training phase lasted approximately 10 minutes for each child. The training introduced the children to using two different implements to represent two levels of different entities in consideration of when these levels might change on the same graph. The test AES extended this activity by requiring children to consider the feelings of the protagonist when reflecting on these events at the end of the experience.

**Test phase**

Children were seen individually in a quiet area in their school within sight of their class teacher or a quiet area in sight of their summer club leader for approximately 20 minutes. They heard one condition appropriate vignette, where the protagonist was either themselves or another age and gender matched child, which described events likely to elicit happy, sad, and mixed emotion experiences. Following the order of administration of Burkitt and Fotheringham (2016) and Oceja and Carrera (2009) recognition of emotions resulting from the vignettes was sought prior to completion of the AES. Children were interviewed about the presence of emotions and possibilities of how and when they were felt because of the end section of the vignette (see Appendix A). The following questions were for the self condition. The term “you” was changed for “they” for the questions for the children in the other condition.

*“How did you feel at end of the story thinking about the events?”*

*“Did you feel anything else?”*

No further questions were asked if children only mentioned happiness or sadness. If they said that happiness and sadness were felt, they were asked the following questions (in extension of previously used interviews [Burkitt & Sheppard, 2014; Burkitt & Watling, 2015; Larsen et al., 2007] to reflect Oceja and Carrera’s [2009] prevalence, inverse, and highly simultaneous patterns of mixed emotion) until the pattern of the emotion occurrence was decided upon. “Was there one feeling and then another?” (*sequential).* If they said yes, no further questions were asked. If they responded no, they were asked “Did you feel both happy and sad at the same time?” (*simultaneous*). If they confirmed this experience, the pattern of the experience was explored until one pattern was identified using the following questions: “Did you feel happy and sad at the same time with more happy or more sad?” (*prevalence*); “Did you feel happy and sad at the same time yet more happy and less sad or more sad and less happy?” (*inverse*), and if they indicated this experience, the follow up part of the question included “and then the other way around?”, and lastly, “Did you feel happy and sad at the same time with more happiness and a little less sadness or more sadness and a little less happiness?” (*highly simultaneous*). Three children needed prompts to explain the highly simultaneous question.

Children then completed the adapted AES graph. Two children required the instructions to be repeated and their data were included in the subsequent analyses. Children wereasked to consider how the protagonist (themselves or another child) felt at the end of the vignette whilst reflecting on the experiences and draw each emotion separately using a red pencil for happy feelings and a blue pencil for sad feelings on the same AES graph, showing intensity of feeling on the vertical axis and duration of feelings about the events on reflection at the end of the story on the horizontal axis (see Appendix B). Each of the lines drawn by the children corresponded to one of the two emotions (happiness and sadness) if they represented mixed emotional experiences. Children’s verbal ability was then measured using the WISC-IV vocabulary subscale (Weschler, 2003).

**Data coding**

**Simple and mixed emotion interview reports.** The children’s interview responses relating to how they or the protagonist felt at the end of the story were coded using the categories of single emotion, sequential emotion and Oceja and Carrera’s (2009) range of simultaneous categories where children’s reports of how the feelings happened reflected each category. Two coders (the lead researcher and an independent coder naïve to the purpose of the study) reached the following level of Cohen’s Kappa for inter-rater reliability accounting for levels of chance agreement on the allocation of reported emotion types to the five categories (*K*=0.92). The discrepancies were resolved through discussion.

**Simple and mixed emotion patterns in AES.** Two adult coders (the lead researcher and a second independent coder naïve to the aims of the study) independently examined the AES graphs selectively coding for instances of Oceja and Carrera (2009)’s pattern of single, sequential, prevalence, inverse, and highly simultaneous types (see Figure 1) and potential additional patterns. The coders also looked for simple single emotion patterns where one or other of the lines depicting happiness or sadness ended and applied an “other” category for responses that lay outside these five patterns. Inter-rater reliability accounting for levels of chance agreement for the allocation of each AES graph to one of the categories was high (*K*= 0.90) and the discrepancies were resolved through discussion. Allocation to the prevalence or highly simultaneous category resulted in the most discussion when resolving discrepancies. Discussion centred around the level of intensity taken between two simultaneous emotions to be coded as either prevalence or highly simultaneous patterns. In line with Oceja and Carrera’s (2009) example, simultaneous emotions that both featured in the upper quarter of the graphs were taken as highly simultaneous.

**Results**

 **Children’s reported and graphed emotion types**

Model selection loglinear analysis with backward elimination was used to explore main and interaction effects of age group (younger vs. older) and condition (self vs. other), separately for each emotion response type (single, sequential, prevalence, inverse, and highly simultaneous, each coded as present or absent), and separately for reported and for graphed responses. Loglinear analyses were run to estimate the single parameters for the resultant models from the hierarchical model selection procedures. Table 1 shows the significant effects remaining in the final models of the hierarchical model selection analysis; the statistics represent the change in chi-square if the effect was deleted from the model. The single parameter (*z* values) estimates for the corresponding contrasts between age groups or conditions are reported in the text below.

*(\*\*INSERT TABLE 1 ABOUT HERE\*\*)*

**Children’s reported emotion types**

 As shown in Table 1, the factors of age group and condition were included in the model selection analysis for each reported emotion response type separately. The final model (χ2 (2) = 2.37, *p* = .87) for single emotions included two significant main effects, with younger children reporting more single emotions than older children (*z* = -1.34, *p* < .001), and with children in the self condition reporting more single emotions than children in the other condition (*z* = -5.12, *p* < .001). The final model for reported sequential emotion (χ2 (4) = 1.74, *p* = .78) showed a significant main effect for age with younger children reporting more sequential emotions than older children (*z* = -3.18, *p* < .001). The final model for reported prevalence emotion types revealed an interaction of age group and condition, with older children in the self condition reporting more prevalent emotion types than younger children in the self condition (*z* = 2.21, *p* = .036). Reports of prevalent emotions in the other condition were proportionally similar between the younger (27%) and older (22%) age groups. A main effect of age group was found for reported inverse emotion types (χ2 (1) = 1.26, p= .86) with the older children reporting more inverse emotion types than the younger group (*z* = 3.28, *p* < .001). The final model for the highly simultaneous emotion types had a main effect of age group (χ2 (1) = 1.21, *p* = .88) where the older children reported more highly simultaneous experiences than the younger group (*z* = 2.06, *p* = .04). The frequencies of reported emotion type by condition and age group are displayed in Table 2.

*(\*\*INSERT TABLE 2 ABOUT HERE\*\*)*

**Children’s graphed emotion types**

 The results of the model selection procedures for the graphed emotion types summarised in Table 1 showed a best fit model for graphed single emotions with a main effect of age group (χ2 (1) = 1.99, *p* = .78). The younger age group graphed more single emotion types than the older age group (*z* = 3.14, *p* < .01). Graphed sequential emotion types were also found to have a final model with a main effect of age group (χ2 (1) = 1.91, *p* = .75). The younger group reported more sequential emotion types than the older age group (*z* = -3.18, *p* < .001). The final model for graphed prevalence types of emotion (χ2 (4) = 6.16, *p*= .68) revealed an interaction between age group x condition. Older children in the self condition graphed more prevalence types than the younger children in the self condition (*z* = 2.21, *p* = .04) whilst responses were proportionally similar in the other condition between the younger (25%) and older (26%) age groups. The final model for graphed inverse emotion types (χ2 (4) = 4.12, *p* = .62) showed a main effect of age group with the older age group graphing more inverse emotion types than the younger group (*z* = 3.29, *p* < .001). A main effect of age group emerged in the final model for graphed highly simultaneous experiences (χ2 (4) = 3.65, *p* = .78), with older children graphing this emotion type more than children in the younger age group (*z* = 1.35, *p* = .04). Table 3 displays the response frequencies of graphed emotion types by condition and age group.

*(\*\*INSERT TABLE 3 ABOUT HERE\*\*)*

**Comparison of interview and adapted AES response trends overall**

A series of McNemar Chi2 tests were run between overall response type frequencies by graph or report across each emotion type separately. Two significant findings emerged for the prevalence (χ2(1) = 26.86, *p* < .001) and the inverse emotion types (χ2 (1) = 23.61, *p* = .02). More prevalence emotion types were graphed (32%) than reported (18%) and more inverse emotion types were reported (34%) than graphed (21%). The data was spilt separately by condition and then by age group and the series of McNemar Chi2 tests were run again between response type frequencies by graph or report across each emotion type separately. No further significant findings emerged.

 Although not a primary aim of the study, verbal ability was analysed separately in relation to interview and AES graph responses to assess if verbal ability predicted the presence of a mixed emotion response (i.e., any mixed emotion report/graph, as shown in the final column of Tables 2 and 3) as found in previous research (e.g., Heubeck et al., 2015). Logistic regression analysis showed that verbal ability predicted the presence of a mixed emotion in the interview reports (**= 0.18, *t* (178) = 3.70, *p* < .001) but not the presence of a mixed emotion response in the AES graphs (**= 0.09, *t* (152) = 12.01, *p* = .09).

**Discussion**

The primary aim of the present study was to extend enquiry into children’s recognition of the possible types of subjective mixed emotion experiences in a childhood population using Oceja and Carrera’s (2009) categories of single and mixed emotion detected in adulthood through extended emotion interviews and an adapted AES. The secondary aim was to assess whether recognition of these emotion types increased with age and / or the type of protagonist. Both measures uncovered children’s recognition of single, sequential and a range of simultaneous mixed emotion experiences in line with Oceja and Carrera’s (2009) categories. In addition, the graphs and reports showed slightly different response patterns, and an impact of measure type on the frequency of prevalence and inverse mixed emotion experiences.

 The reported and graphed responses showed differentiated single, sequential, prevalence, inverse, and highly simultaneous patterns of mixed emotion experiences. The recognition of mixed emotion across this age range supports research indicating that mixed emotion recognition increases during this period (e.g., Berndt et al., 2015; Burkitt & Sheppard, 2014; Burkitt & Watling, 2013; Donald & Westerman, 1986).

As predicted, there were age differences in the types of both reported and graphed emotions, and more complex patterns relating to increasing emotional intensity (Oceja & Carrera, 2009) were graphed and reported more by children in the older group. The younger age group reported and graphed more single and sequential mixed emotion experiences than the older group, and the older group reported and graphed more prevalence (in the self condition), inverse, and highly simultaneous experiences. These findings may reflect a developmental phase through which a recognition of the increasing complexity of emotional experiences in relation to the valence as well as the intensity of the emotion increases (Heubeck et al., 2015; Larsen et al., 2007; Pons & Harris, 2004; Smith et al., 2015).

It was anticipated that there may be greater recognition of the mixed emotion types for children considering the feelings of another child than for those children considering their own feelings given the developmental tendency for children to recognise mixed emotion experiences in others before recognising the experiences in themselves (Burkitt & Watling, 2015; Heubeck, 2015; Larsen et al., 2004). A contrasting finding in relation to condition and age emerged in that older children considering themselves graphed more prevalence emotion experiences than younger children. A tentative explanation could be that the experience of mixed emotional prevalence is harder to detect in other people than in oneself with older children firstly recognising the experience within themselves than in others. The role of social display rules on the responses for each type of measure could be investigated in future studies. It may be plausible that children are more comfortable reporting certain patterns of experience in others than in themselves in relation to a developing understanding of self-presentational behaviour. For example, children are more likely to report positive emotions to people (Banerjee, 2002; Fu & Lee, 2007; Watling & Banerjee, 2007). They may be warier of reporting experiences that involve a mix of both negative and positive feelings than simply reporting single positive emotions.

The increasing complexity of experiences with age could be assessed in relation to a developing biological architecture. As the ESM (Cacioppo, Gardner, & Bernston, 1999; Cacioppo, Larsen, Smith, & Bernston, 2004) postulates, the biological architecture supports positive and negative affect activation in multiple patterns such as reciprocal, co-activated or independent (Norris, Gollan, Bernston, & Cacioppo, 2010) which may support complex activation patterns across mid childhood.

The identified types of mixed emotion experience support Oceja and Carrera’s (2009) refined types of simultaneity and may indicate that the simultaneous experiences are potentially as fine grained in mid childhood as those experienced in adulthood (Carrera & Oceja, 2007; Larsen et al., 2014). Children were interviewed about possible variations in the experience of mixed emotion to a greater extent in the present study than in previous studies, indicating more variability of simultaneous experiences than has previously been identified (Burkitt & Watling, 2015; Donaldson & Westerman, 1985; Larsen & McGraw, 2001; Larsen et al., 2007). The present findings suggest more differentiated simultaneous subjective mixed emotional experiences in this young age range by showing reports and graphs of prevalence and inverse emotion types.

The ways that the subjective mixed emotion experiences were measured revealed significantly different response frequencies for two types of mixed emotion. It was found that more prevalence emotion types were graphed than reported and more inverse emotion types were reported than graphed. This provides tentative evidence to suggest that the amended AES measure could supplement interview responses and should be subjected to further validation. Moreover, in line with previous research, verbal ability predicted overall mixed emotion reports (e.g., Heubeck et al., 2015) yet not graphed responses suggesting that this measure may be less demanding for children across the present age range.

There have been calls to examine the specific types of emotions and how they are both recognised and understood within children’s own felt experiences and their recognition and understanding of the experiences of other people when building a model of mixed emotional experience in childhood (Burkitt & Watling, 2015; Heubeck et al., 2015). These findings offer tentative support for the Circumplex and ESM models of the capacity for possible co-activation of opposite valence emotions for relatively low intensity emotions. The adapted AES could be easily administered in situations where children’s complex emotional reactions are in question. These may include, for example, daily experiences of ambivalence where a parent may chastise a child whilst giving them a hug, or normative events such as receiving a good grade in a disliked subject or transitioning to a new school or a new peer group.

 The applied potential of an adapted AES with further validation could include educational, social, and clinical assessment where interviews may currently underestimate the presence and type of mixed feelings children have about a range of events, topics, and people in their lives. Semi structured interviews, for example the Child and Adolescent Survey of Experiences (Allen, Rapee, & Sandberg, 2012), Personal Experience Checklist (Hunt, Peter, & Rapee, 2012) and diagnostic tests such as the Child Assessment Schedule (Thompson, Merritt, Keith, Murphy, & Johndrow, 1993) could be supplemented by an AES to capture mixed reactions without relying on verbal ability and univariate scale items. Assessment tools such as the Children's Global Assessment Scale (Weissman, Warner & Fendrich, 1990), which may not allow for mixed emotion responses, or the McMaster Clinical Rating Scale, which has shown validity in revealing mixed emotions within families (Drumm, Carr & Fitzgerald, 2000), and the Test of Emotion Comprehension (Pons & Harris 2002) could also be supplemented by using AES graphs to show possible types of mixed emotion experiences.

The children in the present study understood how to use the adapted AES after a brief training phase that lasted approximately 10 minutes. Children’s comprehension of the use of this measure could, however, be further validated. The present mixed emotion experience relied on the memory of a brief vignette. Future research could assess graphs produced as the events unfold such as when children are watching a sequence of bittersweet events in a cartoon which can be linked by children as young as 3 years to past events leading to a protagonist’s current feelings (Pons, Harris, & de Rosnay, 2004; Smith et al., 2015). Further study could also assess whether the patterns produced in the AES are consciously accessible. The similarity of types of reported and graphed experiences found in the present research suggest that this could be the case.

As emotional understanding and reports of mixed emotional experiences tend to vary by emotion and protagonist type (Heubeck et al., 2015), the utility of this measure across emotion types and protagonist type could extend this line of enquiry and supplement models of mixed emotion development across childhood.Moreover, cross cultural facets of a developmental model need to be examined. Experiences of positive and negative affect vary by cultural and personal differences. For example, East Asians tend to experience more dialectic emotions than Westernised American populations (e.g., Miyamoto, Uchida & Ellsworth, 2010) and the relative incidence of subjective types of mixed emotion could be explored cross culturally in childhood.

Overall this study has shown promise for an adapted AES to reveal variation in mixed emotion types in this age range in a slightly different pattern than revealed by verbal reports alone. The measure clearly needs to be validated in further contexts within and beyond this age range. However, it is the first study to indicate this breadth of variation of children’s experience and recognition of simultaneous happiness and sadness.

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Tables

Table 1

*Results of model selection and loglinear analyses for reported and graphed emotion types.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Emotion type | Effect and interaction | *d.f.* | *p* | *z*-value |
| Reported emotion types |
| Single | Age group | 1 | <.001 | -1.34 |
|  | Condition | 1 | <.001 | -5.12 |
| Sequential | Age group | 1 | <.001 | -3.18 |
| Prevalence | Age group x Condition | 1 | .036 | 2.21 |
| Inverse | Age group | 1 | <.001 | 3.28 |
| Highly Simultaneous | Age group | 1 | .04 | 2.06 |
| Graphed emotion types |
| Single | Age group | 1 | <.01 | 3.14 |
| Sequential | Age group | 1 | <.001 | -3.18 |
| Prevalence | Age group x Condition | 1 | .04 | 2.21 |
| Inverse | Age group | 1 | <.001 | 3.29 |
| Highly Simultaneous | Age group | 1 | .04 | 1.35 |

Table 2

*Frequency and* *percentage for each age group and condition of reported emotion types by condition and age group.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Condition | Age group | Single | Sequential | Prevalence | Inverse | Highly simultaneous | Any ME report |
| Self*n*=90 | Younger*n* =46 | 15(33%) | 17(37%) | 2(4%) | 11(24%) | 1(2%) | 31(67%) |
| Older*n* =44 | 2(5%) | 7(16%) | 9(20%) | 20(45%) | 6(14%) | 42(95%) |
| Self Total | 17(19%) | 24(27%) | 11(12%) |  31(34%) | 7(8%) | 73(81%) |
|  |  |  |  |  |  |  |  |
| Other*n*=90 | Younger*n* =44 | 4(9%) | 18(41%) | 12(27%) | 7(16%) | 3(7%) | 40(91%) |
| Older*n*=46 | 1(2%) | 3(7%) | 10(22%) | 24(52%) | 8(17%) | 45(98%) |
| Other Total | 5(6%) | 21(23%) | 22(24%) | 31(34%) | 11(13%) | 85(94%) |
|  |  |  |  |  |  |  |  |
| Grand Total | *N*= 180 | 22(12%) | 45(25%) | 33(18%) | 62(34%) | 18(10%) | 158(88%) |

Table 3

*Frequency and percentage for each age group and condition of* *AES graphed emotion types by condition and age group*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Condition | Age group | Single | Sequential | Prevalence | Inverse | Highly simultaneous | Other | Any ME graph |
| Self*n*=90 | Younger*n* =46 | 8(18%) | 16(35%) | 14(30%) | 6(13%) | 0(0%) | 2(4%) | 36(78%) |
| Older*n* = 44 | 2(5%) | 8(18%) | 20(45%) | 8(18%) | 5(12%) | 1(2%) | 41(93%) |
| Self Total | 10(11%) | 24(27%) | 34(37%) | 14(16%) | 5(6%) | 3(3%) | 77(86%) |
|  |  |  |  |  |  |  |  |  |
| Other*n*=90 | Younger*n* =44 | 4(9%) | 18(41%) | 11(25%) | 7(16%) | 3(7%) | 1(2%) | 39(89%) |
| Older*n*=46 | 1(2%) | 3(7%) | 12(26%) | 18(39%) | 12(26%) | 0(0%) | 45(99%) |
| Other Total | 5(5%) | 21(23%) | 23(26%) | 25(28%) | 15(17%) | 1(1%) | 84(94%) |
|  |  |  |  |  |  |  |  |  |
| Grand Total | *N*= 180 | 15(8%) | 45(25%) | 57(32%) | 39(21%) | 20(11%) | 4(2%) | 161(89%) |

Appendix A

Vignettes for self and other conditions

 **Self**

*Please imagine that you have just moved to a new town with your family. You used to live in a small village where you had a very close friend. You went to the local village school which you loved. You went everywhere together and loved to play games together. But now you have moved far away from everything you loved. You did not know anyone to play with for a long time. Yet after a while you made a new friend at the new village school. You go everywhere together and most of all you love to play games together. One evening you think a lot about your old friend where you lived before and your new friend where you live now from school.*

**Other**

*Please imagine that boy /girl has just moved to a new town with their family. He/she used to live in a small village where they had a very close friend. The boy/girl went to the local village school which they loved. They went everywhere together and loved to play games together. But now he/she has moved far away from everything that they loved. He/she did not know anyone to play with for a long time. Yet after a while he/she has made a new friend at the new village school. They go everywhere together and most of all they love to play games together. One evening he/she thinks a lot about the old friend where they lived before and their new friend where they live now from school.*