Measuring emotional granularity in school-age children.

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Abstract

Dense longitudinal experience sampling studies with adults have shown that high emotional granularity scores are associated with better emotion regulation skills and lower prevalence of some psychiatric symptoms and disorders. Given the inherent difficulty in data acquisition, investigations applying this same methodology during development are still scarce. Here we present the first study of emotional granularity measured from a dense longitudinal experience sampling procedure in school-age children. Two hundred and sixty four children (ages 9 to 13 years old, mean = 10.4 ± 0.9) assessed their emotions with likert scales in three different weeks: one week before, one during and one after a four-month school-based psychoeducational program. Behavioral problems and social skills were also assessed before and after the same intervention in a separate sample of 113 children (ages 7 to 13 years old; mean = 9.3 ± 1.5). Small to moderate improvements in social skills were observed after the psychoeducational intervention in comparison to baseline. Regarding emotional granularity, a moderate improvement was observed for the discrimination of positive emotions after the intervention. Interestingly, responses to disgust and social emotions (jealousy, guilt, shame and envy) showed no significant variance throughout the samplings, suggesting that these emotion concepts are not usually applied, by school-age children. Our findings suggest the feasibility of assessing emotional granularity in school-age children and show an improvement in positive emotional granularity after a psychoeducational program, which have also improved social skills. Finally, challenges and further directions for properly applying emotional experience sampling in children are discussed.

Keywords: Emotional Granularity; Experience Sampling; Emotional regulation; Psychoeducational interventions; Social emotions; School-age children.

Introduction

Psychological constructionist approaches make the prediction that emotions are mental events constructed by more basic psychological processes (Russel, 2003; Barrett, 2013; Lindquist, 2013). Accordingly, emotions are concepts created in the mind of a perceiver to fit a certain situation. Given that words are the main support for human conceptualization, language then becomes a constitutive element of emotional processes. In this view, an instance of emotion arises when a concept integrates interoceptive and contextual information (Barrett, 2012; Wilson-Mendenhall et al., 2011; Lindquist, MacCormack & Shablack, 2015).

Emotional granularity has been increasingly used as a construct to operationally define the ability to experience and discriminate emotions (Lindquist & Barrett, 2008b). A person with low emotional granularity tends to use superordinate categories of emotion (e.g., “pleasant” and “unpleasant”). Therefore, that person not only will tend to communicate about affective experiences in a broader manner, but may also effectively experience such states as broad and undifferentiated. Alternately, individuals with higher emotional granularity are capable of discriminating a wider range of emotional states and to use subordinate categories (e.g., they may use “frustration,” “annoyance,” and “rage”, rather than just “anger”). Hence, they may also subjectively experience more specific and detailed emotional states (Lindquist & Barrett, 2008a, 2008b; Smidt & Suvak, 2015).

The measurement of emotional granularity is generally performed by assessing the connections between emotional adjectives after repeated self-reports of emotional states with likert scales of such adjectives (Feldman, 1995; Barrett, 1998, 2004; Lindquist & Barrett, 2008a, 2008b; Smidt & Suvak, 2015). Individual structural differences in the conceptual system for emotions may be a source of variation in how people describe their feelings, leading to variations

in granularity. Hence, changes within conceptual systems during development might lead to differences in emotional experience and granularity (Widen & Russell, 2008; Lindquist & Barrett, 2008b). However, to date, research efforts for measuring emotional granularity have been placed only in adult populations (Lindquist & Barrett, 2008b; Lindquist, MacCormack & Shablack, 2015).

High emotional granularity has been associated with several adaptive behaviors in adults, such as reduced impulsivity (Tomko et al, 2015) and aggression in states of anger (Pond et al., 2012), and better overall emotion regulation (Barrett, Gross, Christensen & Benvenuto, 2001; Lee, Lindquist & Nam, 2017, but see Kalokerinos et al., 2019). Similar effects may already occur at younger ages: children who struggle to convey their emotional experiences exhibit more worry and signs of depression (Rieffe et al., 2007). Furthermore, it has been shown that teaching children to identify and describe emotions is associated with improved social and emotional regulation skills, as well as with better academic outcomes (Harris, de Rosnay, & Pons, 2005; de Rosnay, Pons, Harris, & Morell, 2004).

Considering the potential influences of emotional granularity on behavioral, affective and social outcomes during development, we sought to assess this construct in primary school children before and after a psychoeducational intervention focused on emotional regulation and social skills. We expected that our intervention would improve behavioral outcomes and also increase emotional granularity. Moreover, the viability and challenges of acquiring longitudinal and ecological data on emotional states in children are discussed alongside our findings.

Methods

Participants

Children from all classes from the third to the fifth grade of a public school in the outskirts of Ribeirão Preto were invited to participate in the study. A total of 377 children composed the starting sample. Teachers of 113 children responded to a battery of behavioral measures. Granularity measures were acquired from 264 children. The parents (or legal guardians) of all children gave written permission to their participation, and written consent was also obtained from the children themselves. The teachers that responded to the behavioral scales also gave written consent to participate. This work was approved by the UFABC's Research Ethics Committee.

Behavioral scales

QRSH-Pr. The Socially Skilled Responses Questionnaire for Teachers (QRSH-Pr, in portuguese) is composed of 24 items, scored from 0 (never exhibits behavior) to 2 (always exhibits behavior). Example of items are “Plays with classmates” and “Makes compliments”. It was developed and validated by Bolsoni-Silva, Marturano and Loureiro (2009). The QRSH-Pr was administered by teachers at the psycho-educational program's first and last weeks. The scale is divided into four subscales: Relationships (13 items), Academic Interest (three items), Assertiveness (eight items) and Total.

ECI-B. The Rutter Child Scale B is a screening tool to detect internalizing and externalizing behavior displayed in school by children, designed to be answered by teachers. The brazilian adaptation of Rutter's original work (Rutter, 1967) was done by Santos (2002). The

scale is composed of 26 items, scored from 0 (never exhibits behavior) to 2 (always exhibits behavior). It is divided into the following sub-scales: Aggressiveness (six items), Internalizing Symptoms (five items), Academic Disinterest (four items), Hyperactivity (four items), Physical Symptoms (seven items) and Total. The scale was administered by teachers at the psychoeducational program's first and last weeks.

Emotional experience-sampling

Children received printed lists of likert-scales of emotions. They were instructed to mark four times a day how much of each emotion they were feeling at that particular moment, from 0 (not at all) to 7 (a great deal). The lists consisted of 6 emotions of positive valence (joy, euphoria, enthusiasm, excitement and tranquility) and 9 of negative valence (sadness, anxiety, anger, disgust, shame, jealousy, envy, frustration and guilt), the order of emotions was randomized in each list. Each sheet had 4 lists and each list was identified by the date and hour of completion. Experience-sampling was applied for a week at the start of the psycho-educational program (see below), two months into the program and at its last week. In order to maximize children answering, teachers were asked to remind the children of this task every day at school.

Psychoeducational program

Teachers were trained to administer a weekly, two-hour, psychoeducational activity in the classroom. The activities consisted of discussions based on graphical material such as representations of emotions and short stories. The topics addressed were: identification and naming of emotions, emotional regulation strategies and social skills. The program was based on

educational interventions proposed by Alzina et al. (2009, 2015; Alzina, González & Navarro, 2015) and was developed and implemented by the *Inteligência Relacional* company. This psychoeducational program was part of educational public policy and has been applied in large scale in Brazilian schools.

Emotional granularity indexes

In order to compute indexes of emotional granularity, we followed the procedure described by Barrett (2004): for each participant, [1] calculate Pearson's rho for each pair of emotion from all responses at a given period (before, during or after the psycho-educational program), [2] Z-transform the correlation indexes, [3] subtract 1 from the correlation modules. This leads to a granularity index for each pair of emotions. One can then calculate the average of positive valence emotions to obtain the Positive Emotions Granularity Index (PGI), do the same for negative emotions to get Negative Emotions Granularity Index (NGI), or calculate the general mean to get the General Granularity Index (GGI).

Subjects that responded to less than five lists before or during and after intervention in total were excluded from the analysis due to an insufficient number of responses to calculate correlations. Subjects with zero variance in responses on any of the emotions and stages were also excluded.

Perfect correlations precluded a correct calculation of granularity indexes because of the logarithms involved in Z-transformations. If a perfect correlation was obtained, its value was replaced by the next highest correlation with the same emotional valence.

Analysis was conducted in R (version 3.4; R Core Team, 2015), with the IDE RStudio (version 1.1; RStudio Team, 2015), using custom scripts. Correlations were computed with the

package Hmisc (version 4.0, Harrel Jr, 2016).

Statistical comparisons

Granularity indexes from before and after the psychoeducational program were compared with Mann-Whitney Test for paired samples. These tests were one sided, since the hypothesis was that the educational program should improve emotional granularity, i.e. granularity indexes should be higher after completing the program. Behavioral scale scores from before and after the intervention were compared with two-sided tests.

Results

Experience sampling data

Of the 264 children that performed the experience sampling procedure, 246 responded to at least five lists in the first week of the educational program, 96 after two months, and 28 in the last week. Moreover, 89 children provided data in the first week of intervention and at least one of the subsequent sampling waves. The vast majority (90%) of children who responded to enough lists presented zero variance in their responses for some emotion at some stage, with a total of 24 children ($\text{age} = 10.4 \pm 0.9$) remaining for the granularity analysis . Due to this substantial reduction in the available data , we combined the intermediate and final waves into a single group, called hereafter “after intervention”. If a child presented valid granularity indexes in both stages, the average index was considered.

Children don’t discriminate most social emotions and disgust

The distribution of standard deviations of responses, before excluding the participants

with uniform responses (i.e. zero variance in some emotion, $n = 89$), can be seen in Figure 1.

Many social emotions, including jealousy, guilt, shame and envy, and also disgust, all presented medians below one. This indicates a very low variation of responses for half of the answers.

Wilcoxon signed rank tests were performed on each emotion to evaluate if their medians were statistically lower than one (one sided test), p-values were FDR corrected. This was confirmed with significant results for the emotions of disgust ($V = 1271$, $p = 0.006$, effect size = 0.29), jealousy ($V = 1359$, $p = 0.014$, effect size = 0.25), guilt ($V = 1235$, $p = 0.006$, effect size = 0.29), envy ($V = 1057$, $p < 0.001$, effect size = 0.36) and shame ($V = 1489$, $p = 0.05$, effect size = 0.2).

Figure 1: Standard deviation distribution for experience sampling, diamonds show means.

Behavioral scales shows improvements of interpersonal relationships

The final sample size used in the behavioral scales was 113 (age = 9.3 ± 1.5), and the results obtained for each scale will be described separately below.

QRSH-Pr. Most QRSH-Pr subscales (Table 1) did not show improvements from start to end of the psychoeducational program. The positive change in the Relationships subscale was the only one to reach statistical significance ($V = 2956$, $p = 0.01$, effect size = 0.24). Total score showed a difference of small effect size ($V = 3220$, $p = 0.07$, effect size = 0.17).

Table 1: QRSH-Pr Scores.

Intervention	Min	Max	Median	Mean	SD
Relationships					
Before	2.00	26.00	18.00	17.20	6.99
After	2.00	26.00	20.00	18.41	6.17
Assertiviness					
Before	0.00	16.00	10.00	10.03	4.06
After	2.00	16.00	11.00	10.19	3.23
Academic Interest					
Before	0.00	6.00	5.00	4.42	1.80
After	1.00	6.00	5.00	4.45	1.49
Total					
Before	7.00	48.00	33.00	31.65	11.76
After	5.00	48.00	34.00	33.04	9.82

Note. Before and after refer to time relative to psycho-educational intervention.

ECI-B. All ECI-B scores (Table 2) reduced after the psychoeducational program, when considering the absolute score values. Statistically significant results of reductions were observed

for the subscales of Lack of Academic Interest ($V = 478$, $p = 0.01$, effect size = 0.24), Aggressiveness ($V = 475$, $p < 0.01$, effect size = 0.24), Physical Symptoms ($V = 438$, $p = 0.02$, effect size = 0.22), Hyperactivity ($V = 915$, $p < 0.01$, effect size = 0.26), and also for the Total Score ($V = 1275$, $p < 0.001$, effect size = 0.32).

Table 2: ECI-B Scores.

Subscales	Min	Max	Median	Mean	SD
Aggressiveness					
Before	0.00	11.00	1.00	2.84	3.26
After	0.00	11.00	1.00	2.26	2.96
Internalizing Symptoms					
Before	0.00	7.00	3.00	2.83	1.91
After	0.00	7.00	2.00	2.56	1.88
Academic Disinterest					
Before	0.00	8.00	1.00	1.46	1.72
After	0.00	7.00	1.00	1.16	1.48
Hiperactivity					
Before	0.00	8.00	2.00	3.17	2.80
After	0.00	8.00	2.00	2.74	2.76
Physical					
Before	0.00	7.00	0.00	1.18	1.66
After	0.00	7.00	0.00	0.85	1.46
Total					
Before	0.00	33.00	9.00	11.22	8.68
After	0.00	31.00	7.00	9.23	7.93

Note. Before and after refer to time relative to psycho-educational intervention.

Intervention improved granularity for positive emotions

Average positive, negative and total granularity indexes are shown in Table 3. While the negative and total granularity indexes remained unchanged, the positive granularity index

improved with the psychoeducational program with a moderate effect size ($V = 162$, $p = 0.055$, effect size = 0.39).

Table 3: Granularity indexes.

Granularity Index	Min	Max	Median	Mean	SD
Positive Granularity					
Before	0.35	0.92	0.78	0.73	0.14
After	0.44	0.92	0.80	0.77	0.11
Negative Granularity					
Before	0.37	0.92	0.79	0.75	0.13
After	0.37	0.85	0.81	0.74	0.13

Note. Before and after refer to psycho-educational intervention.

Discussion

A prediction from the theoretical framework of constructed emotions is that children should improve their emotion differentiation skills (i.e., present greater emotional granularity) after learning emotion concepts and their proper contextual uses. The empirical investigation of this prediction, however, is challenging, since it requires the assessment of a reliable measure of emotion differentiation in children. Currently, the most reliable methods for measuring emotional granularity require ecological and longitudinal data acquisition. Such requirements lead to concerns on how to make the material of data collection suitable and engaging for children, and how to guarantee their commitment on recurrently providing responses throughout the days and weeks. In fact, similar challenges are generally present in studies with adults, and they may, at least partially, account for the high dropout rates under such protocols (Barrett & Barrett, 2001).

Here we report the first successful measurement of emotional granularity in children. Moreover, such measures were acquired longitudinally before and after a psychoeducational intervention, which focused on the improvement of emotion differentiation and social skills. Previous evidence has been reported on the impact of a short intervention aimed to broaden school-age children knowledge of emotion words: a one-year intervention improved academic performance and social behavior (Brackett, Rivers, Reyes, Salovey, 2012).

In our study, we observed a moderate increase on the discrimination of positive emotions after our psychoeducational intervention. In contrast to negative emotions, positive emotions are thought to share a common trigger, i.e., the acquisition or expectation of a situation or object increasing well-being (Alzina, 2015). Regarding negative emotions, emotional triggers may vary considerably, for instance: threat perception for triggering anxiety, loss or expected loss of something or someone for sadness, perception of a barrier for anger and self-awareness, and social cognition for complex emotions like shame, guilt and envy (Alzina, 2015). Given this fundamental difference between positive and negative emotions, we argue in favour of the separate description of positive and negative emotional granularities. Additionally, we can further speculate that the discrimination between different negative emotions, particularly negative social emotions, would require more sophisticated mechanisms and would be more variable during development. Such hypothesis would imply weaker effects of short interventions on negative emotion granularity.

Accordingly, we have observed a lack of variability on children responses for complex negative emotions, such as shame, guilt, envy and disgust. All of these emotions require self-evaluation or evaluation of a social situation. Despite previous evidence showing that the broad capacity to express self-evaluative emotions (e.g., guilt) is already established in children as

young as 3 years old (Ross, 2017), our results suggest that school-age children do not usually apply these categories to report their momentary feelings in everyday contexts. Moreover, our finding is consistent with the notion that emotional skills would depend on the complex and intertwined development of self-awareness, metacognition and social understanding, taking place throughout childhood and adolescence (Nook, Sasse, Lambert, McLaughling & Somerville, 2018).

Some methodological concerns revealed in our study should also be addressed in future investigations. First, the involvement of teachers and parents for helping children to sustain their response schedules during data collection was of utmost importance, since it allowed children to integrate the activity of providing responses into their routines. Second, because we had expected high drop-out rates, a substantially high number of participants was initially recruited. The importance of this precaution was indeed confirmed, since we ended up with only about 10% of our starting sample. However, it is important to point out that the tools we used in the data collection, i.e. pen and paper, might not provide the ideal conditions for executing the task. Rather, dedicated devices or smartphone apps for digital responding, which are already in use for experience sampling procedures with adults (Barrett & Barrett, 2001; Christensen, Barrett, Bliss-Moreau, Lebo & Kaschub, 2003; Kalokerinos, Erbas, Ceulemans & Kuppens, 2019), may offer good opportunities for data collection in children, provided some adaptations. The use of such tools should also help to mitigate data loss due to situations of poor engagement on responding.

A final point of concern to be addressed by further investigations consists on the adequacy of current methodological instruments for the assessment of emotional concepts development during childhood, particularly during transition to literacy. Here we applied a

aprocedure designed to be used in adults samples, in which the support for emotional concepts representation are based on established semantic, reading and writing skills. Furthermore, a rigorous validation of the list of words is advisable before extending this methodology to other research questions.

In summary, we presented the first assessment of emotional granularity in school-aged children to date and showed that an improvement in social skills after the application of a short socio-emotional education program was accompanied by an improvement on positive emotional granularity. Despite not being our primary research aim, we have also observed that children did not show relevant discriminative use of social emotions in a daily basis.

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