Multimodal Sentiment Analysis of Nursery Rhymes for Behavior Improvement of Children

Makarand Velankar[1*], Vaibhav Khatavkar[2], Dr. Parag Kulkarni[3]

[1]Assistant Professor, MKSSS Cummins College of Engineering Pune, 411052. And Ph.D. Research Scholar PICT, Pune Maharashtra, India.*
[2]Ph.D. Research Scholar College of Engineering Pune, Maharashtra, India.
[3]CEO and Chief Scientist at Kvinna Limited, Pune, Maharashtra, India.

Abstract: *Introvert children have behavioral issues such as self-centric, poor communication, low confidence, less participation and physically weak, whereas hyperactive children have issues related to non-obedient, aggression, lack of patience, lower concentration levels, and disturbance to others. There is a need to do some remedial measures to improve the behavior of children for their better future. Music interactions with the specific sentiment, i.e. positive sentiments for introvert and negative sentiments for hyperactive children are a proposed approach used. Multimodal analysis of 50 nursery rhymes using cognitive music models with analysis of lyrics and acoustic parameters was performed to select rhymes in specific categories. Specific sets of rhymes were repeatedly played and the behavior was observed and noted for specific predefined parameters by teachers and parents. The improvement noticed in the initial 3 months with about 10 musical sessions per month was in the range of 20 to 40 %. This is probably the first kind of study to use multimodal music sentiment analysis for the behavioral improvement of kids with hyperactive and introvert characteristics. The study also provides effective use of selected acoustic and text features with a normalization approach for sentiment analysis.*

Keywords: **Multimodal sentiment analysis; Music interactions; children's Behavior improvement; nursery rhymes.**

1. Introduction

According to renowned psychologists like Sigmund Freud [1], childhood has a profound effect on the development of human psychology. Similar observations were noted by many researchers related to children [2-3]. The childhood experience is built by extracting information from the environment with the preliminary senses, such as touch, smell, vision, taste, and hearing. Child psychologists observing behavior and issues of children at an early age have come up with the terms as hyperactive and introvert to represent specific behavior among children. The problem observed about a hyperactive child full of energy is to showcase the abilities like to dominate others, tend to perform activities that are at times dangerous to them and others, etc. An introvert child with fewer reactions to the external world has issues related to the expression of emotions, quiet, and no or less participation in sports and other activities, etc.

The problem of specific children having an age group about 3 to 4 years was mentioned by the school teacher teaching at the nursery level during one informal get-together. According to the observations by the teacher, some children were hyperactive

and some introvert. This problem needed specific attention and some remedial actions. After initial discussions with the teacher, she discussed the issue with the parents and validated her observations in the school. The behavior of children was similar at home and it was decided in consultation with the parents that something needs to be done to change the behavior. Various options were discussed including pet and music therapies. It was decided to explore the use of music in an attempt to improve the behavior of children.

Hyperactive children are categorized as having Attention-Deficit Hyperactivity Disorder (ADHD) [4] and music therapy is used as an effective tool to address this issue. Instructional and improvisational models of music therapy were proposed and experimented for 13 adolescent boys with ADHD [5] to improve motor skills and no firm conclusions could be drawn about the approach that may have contributed to a reduction of impulsive and restless behaviors. As per the observations and the survey conducted [6], systematic reviews of trials of music therapy in ADHD have not been conducted and the exact effectiveness of music therapy is still unknown. During the empirical studies on the effects of music education on cognitive, social-emotional, and motor functioning of children [7], it was observed that majority studies reported positive or moderate positive effects of music interactions.

Introvert children have behavioral issues such as no or limited response, no initiative for participation in group activities, not a part of a team as a collaborative activity and tend to remain aloof most of the time. Group assignments, peer learning are the well-accepted norms in the teaching-learning pedagogy. Introverted children find it difficult to adopt these learning approaches. Teamwork is an essential behavioral requirement in the professional world for success. It is necessary to pull them out of their shell considering the importance of team and need foreffective interpersonal communication. Introvert children are generally creative and they can use their inner powers more effectively [8]. During the experiment investigated, the cognitive performance of introverts and extroverts under conditions of simple and complex musical distraction [9], the performance of extrovert children was found better compared to introvert children. Introvert performs better in silence, whereas extrovert perform better with music was the result of the research performed for people during work [10]. During the study of personality and music taste, it was stated that “one should not use the same relaxing or energizing music on both groups: extraverts and introverts” [11]. Further, it was observed that music with a high stimulative value, as preferred by extraverts, may lead to stress in introverts and vice a versa. Similar experiments based on 5 different personality traits revealed that it barely account for inter-individual differences in music preferences, however, musical functions may provide better explanation [12]. During the music therapy experiments with autistic children, nursery rhyme activities were adapted within the home settings provided better results [13]. Music therapy can improve mood, language, sensory perception, behavior, and social skills in children with autism [14]. The qualitative analysis of the music therapy experiments with infants [15], showed that music therapy helped parents to connect with their children better in the hospital environment. The effect of musical motifs, which represents a repeated portion of the song for music therapy, was studied for children's externalizing behaviorproblem improvement [16]. Music therapy improves cognitive function and behavior in patients with moderate Alzheimer’s disease as per the study conducted [17]. Many researchers have focused on the use of music therapy for children or patients with specific disorders and observed that music therapy helps with behavior improvements. This study has led us to the thought of exposure to specific music as a possible remedy measure.

The hypothesis is formulated considering the outcome of the literature survey and derived notions. The hypothesis is the exposure of the negative sentiment rhymes for the hyperactive children and positive sentiment rhymes for introvert children may help to overcome the issues and balance the conduct. The assumption was opposite sentiments may be attractive to children (opposite poles attract) and may help to balance the activities. For example, for a naughty active child, negative sentiment rhymes may be useful in balancing and he/she may learn a rhyme quickly as compared to positive sentiment rhyme. Further, the experiments with observed in the behavior of children when exposed to specific music were used to test the

hypothesis. Considering the pilot experiment, 18 English nursery rhymes (9 rhymes of negative and 9 of positive sentiments) were chosen for the sentiment analysis done for 50 rhymes. 3 children of each category were exposed to specific music to test the hypothesis. The parameter decided was a change in behavior from the observations by parents and teachers.

Music exposure was decided to be conducted at home considering the mood of children and flexibility was given to parents about active involvement/ possible sessions/ time/day per week. It is difficult to isolate the exact impact of music during the first 3 months as the parent's involvement/ interactions and quality time spent, along with the child may have a certain impact on behavioral improvement. During the 4^{th} month, no involvement of parents during the music listening session was strictly followed.

Behavior changes are measured as social behavior with peers, parents, teachers, family members, i.e. interpersonal behavior observed mainly. Responses during common situations and standard simple questions were observed by parents and peer behavior was mainly observed during school time by teachers. Behavior checklists were prepared for observation of hyperactive and introvert children. It included standard behavioral patterns to be observed in specific children. Parents and teachers were free to add new observed phenomenon and remarks about the same. The orientation of the checklist parameters was specific to the children with some common observable parameters. Common parameters were decided based on the discussion with the parents and teachers. The behavior observed before the musical interactions and after the exposure of music in similar or same situations was the main basis for change in behavior. The common parameters along with some additional parameters specific to a child were used to note the behavioral change.

Behavioral change is a noticeable expected change in the response of the children in a similar situation before. For the introvert children, response to open-ended questions, interactions with family members or visitors were major observational factors by parents. For the hyperactive children, the level of concentration in performing different activities, disturbing or destructive activities were major observational factors by parents. For the teachers, the observed factors were interaction in the class, peer interactions, dominance level for hyperactive children and participation level for introvert children in various activities. Expected change in the behavior noticed compared to previous experience is termed as behavior change for the children under observation.

Initial experiments were targeted for 6 children (3 hyperactive and 3introvert). No special needs and no specific permissions were required to perform the experiments. The experiments were planned in consultation with the teachers and parents with a nondisclosure agreement about the name of the school and children to keep the names secret to avoid future problems if any. The listening sessions took place at home with parental involvement using the audio files shared with them on their mobiles. The same audio files were played by the parents for the listening sessions. We provided the liberty to parents to plan the session as per their availability and considering the child's mental levels and acceptance to listen to rhymes. This flexibility helped to plan the listening sessions more effectively without any burden on parents and children.

2. Related work

The children may hear lullabies from the mother at an early stage as probably the first interaction with the music. The importance of music in preschool education was being explored by researchers [18-20]. Nursery rhymes are generally our initial contact with the fascinating world of music in our childhood. Nursery rhymes are composed and build with objectives such as teaching children values, educating like counting numbers, stories for building imagination and creativity, association with objects or places, etc. Children perform activities such as clapping, showing objects, or performing some tasks such as wearing shoes while singing or listening to the rhymes. These songs are performed as a group activity or

individually by children with enjoyment. During 20 years of research, related to nursery rhymes for children's development, it was observed that children benefit greatly when parents are involved in the nursery rhyme interactions [21]. Similar observations were noted by researchers with a focus on nursery rhymes for the development of language and other skills. [22-24].

Sentiment analysis for music has been used by researchers with different approaches for various genres [25-26]. Lyrics text mining for mood classification [27] and mood classification using lyrics and audio [28] were some of the examples to analyze music sentiments. The multimodal approach was used by different researchers [29-30] to investigate the sentiments for music. This was a motivation to propose a multimodal system for the nursery rhymes. The textual lyrics analysis using a bag of words approach and generating vector using Doc2vec [31] was used in Telugu songs. Lyrics and audio feature combination [32] was used for mood classification for western songs. Textblob (python library) was successfully used for text analysis [33] related to twitter data. Sentiment analysis with a hybrid approach, including polarity prediction of Textblob for documents [34] provided better accuracy for different data sets. Multimodal fusion approach with text and acoustic analysis was deployed for YouTube video reviews and audio respectively [35]. The multimodal approach has provided a significant improvement over individual modes for sentiment analysis as per the results indicated. Considering the survey, a multimodal approach was proposed for sentiment analysis of nursery rhymes using lyrics text and audio for the experiments. Many tools are available for text sentiment analysis, such as Sentiwords, Textblob, NLTK, etc. Textblob is a python library and it is built on top of NLTK. Word embedding is another approach for sentiment analysis, but it requires training the model and time required is more in word embedding approach.

Various tools are available for acoustic feature extraction. Jaudio is a free, open-source tool developed in Java for audio feature extraction.Various features such as root mean square energy, Mel Frequency Cepstral Coefficients, spectral centroid, spectral roll-off are useful for music emotion recognition. The tempo has been an important acoustic feature for emotion perception and fast tempo associated with happier or positive sentiments, whereas slow tempo is associated with sad or negative sentiments. Music therapy has been used for autistic children, mainly for the enhancement of various skills and it has shown good results [36]. Other approaches such as the use of virtual reality were used to improve conversational skills for autistic children [37]. Experiments with music interactions as a tool have resulted in solving behavioral and emotional problems with children to a certain extent [38-39]. This detailed literature survey helped us to decide the specific acoustic features for audio sentiment and the use of textblob for lyrics for text sentiment analysis in the resultant multimodal sentiment analysis of nursery rhymes.

3. Materials and Methods

The history of rhyme is useful for the parents to select rhyme considering the association possible for the children. As an example, a parent residing in the UK can give his pal a rhyme which contains history or data related to the UK for reference. This may help a child to increase his association abilities. The objective of this work was to extract the sentiments from various modes of the nursery rhymes and build a sentimental context of music useful for the selection of the nursery rhyme. Further, the validation of the contextual information was performed from the response and interaction of children with the nursery rhymes.
The issues related to children urge the requirement of a system that can be used by parents to select an appropriate nursery rhyme for their children. The proposed system will have input as a query from parents and output a list of possible songs as shown in Figure 1. Text preparation will include nouns and verb extraction. Text processing will identify the context and semantic

information associated with the query to recommend songs. The proposed system to search for specific rhymes in its present state hasa limited set of rhymes for sentimental context identification.

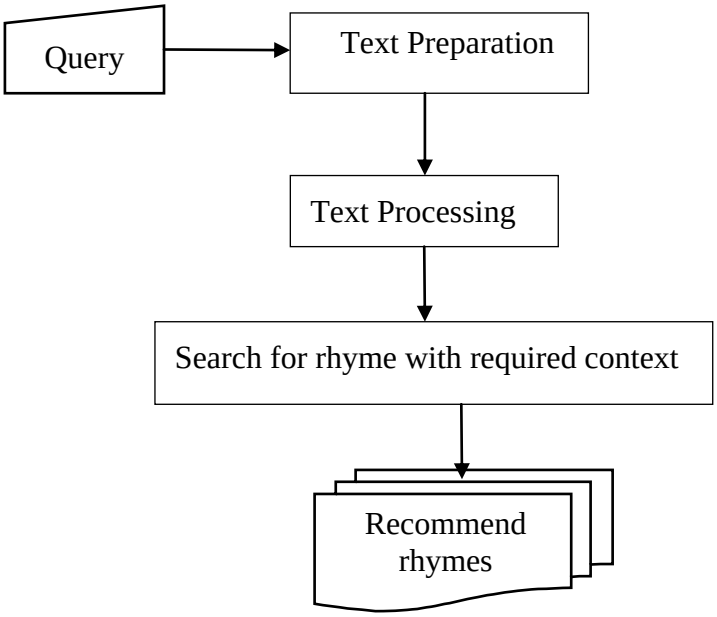

Figure 1: Proposed system to search nursery rhyme

Lyrics text data associated with rhyme were processed using Textblob (python library) to predict the sentiments associated with the lyrics. Audio features were extracted using the Jaudio tool to predict the sentiments from the acoustic information. Rhymes with both sentiments (lyrics and audio) as positive and negative were selected for experimentation. Different versions of audio of the same nursery rhyme are available and they predict different sentiments. Multimodal information of songs as lyrics and audio data was used for identification of the sentiments. Figure 2 shows the sentiment analysis system used for nursery rhymes to identify possible sentiments associated with rhyme. This methodology with text and audio analysis used by researchers to model sentiments associated with music, which is referred to as multimodal analysis. Music sentiments are a combined effect of multimodal information such as lyrics, acoustic features, etc. This experiment uses multimodal information to associate sentiments with nursery rhymes using lyrics and acoustic features.

The sentiment analysis of popular nursery rhymes was performed to find suitable rhymes for the children. It was not appropriate to discriminate against the children and also difficult to expose them to specific music in school. The approach decided was making children listen to specific nursery rhymes at home. Music interactions were planned with parents at their homes and observations were planned at school and home. It was also decided to keep the names confidential considering the possible future issues. The children identified in the experiments were of the age of 3 to 4 years studying at Mini and Junior KG levels in pre-primary school.

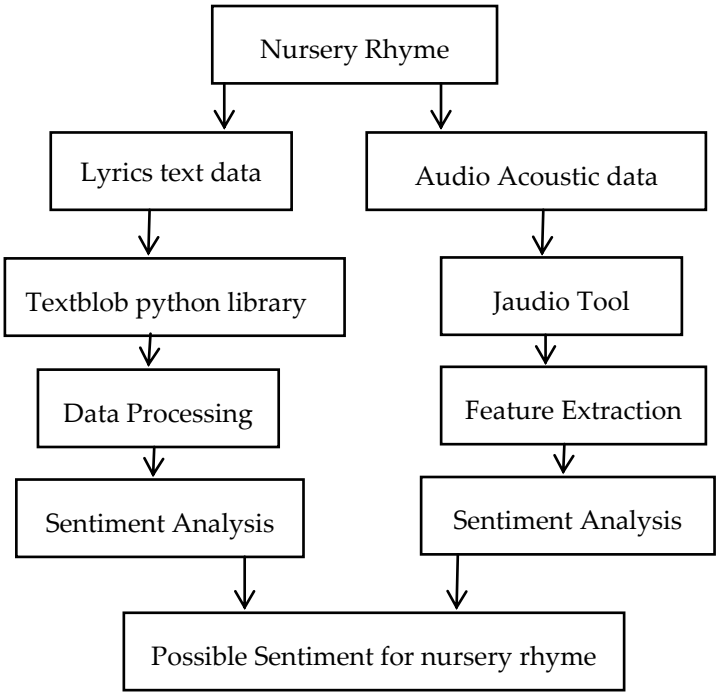

Figure 2: Nursery rhyme sentiment analysis system

3.1. Sentiment Analysis using lyric data

Sentiment analysis is a part of Natural Language processing and music is considered as a language of communication. Lyrics in the textual form were examined for the sentiment analysis. Present experimentation uses Textblob for sentiment analysis of nursery rhymes. The lyric text was the input and estimated sentiments with polarity and subjectivity as the output of the algorithm. Sentiment analysis of lyrics associated with song provided us polarity with positive or negative values or zero to represent neutral. The polarity scores are within the range [-1.0, 1.0] and the subjective scores are within the range [0.0, 1.0]. Polarity score 0 indicates neutral and the number more towards 1 or -1 indicates it is more positive or negative respectively. Subjectivity score near 0 indicates more objective and near 1 indicates more subjective. The following example illustrates the sentiment analysis done. In the popular nursery rhyme, 'Twinkle Twinkle little star', the polarity and the subjectivity of the lyrics were - 0.1143 and 0.3 respectively, which tells that the rhyme is on the negative sentiment side and on the least objective. The objectivity of a sentence is more if the sentence is more factual. The factual sentences give concrete or discrete results like in terms of yes/no. If the sentences are non-objective they are Subjective. Songs with negative polarity support were likely candidates one set and with positive polarity were identified for another set. Randomly selected 9 songs for each category are presented in table 1 with sentiments and the polarities of lyrics calculated.

Table 1. Randomly selected Songs for experiments with negative and positive sentiments estimated from lyrics of the nursery rhymes.

Title of song	LyricsPolarity Score	Lyrics Subjectivity Score
Bye baby bunting	-0.227777778	0.444444
Cock a doodle doo	-0.125	0.433333
5 little speckled frogs	-0.035714286	0.707143
Frere Jacques	-0.258333333	0.566667
Little boy blue	-0.010525174	0.645833
Lucy locket	-0.179513889	0.447222
One two buckle my shoe	-0.25	0.5
Rain rain go away	-0.1875	0.5
Twinkle twinkle little star	-0.114285714	0.3
Ding dong bell	0.275	0.325
Eeny meeny miny	0.025	0.25
It's raining its pouring	0.25	1
Jack spart	0.044444444	0.512962963
Mary mary quite contrary	0.283333333	0.416666667
Pat a cake baker's man	0.291319444	0.612847222
Pussy cat pussy cat	0.049553571	0.358928571
Hot cross buns	0.458333333	0.7
Row rowrow the boat	0.028125	0.35

3.2. Sentiment Analysis using audio data

The meaning and contextual information are extracted from various multimodal sources such as historical information, lyrics, and audio. Acoustic features are instrumental in conveying the meaning and sentimental information. Features in the acoustic signal to provide cues for the intended message to be conveyed. The importance of RMSE (root mean square energy), tempo and spectral features for music emotion recognition from the literature survey prompted to use these features for nursery rhymes audio sentiment analysis.

Acoustic features were extracted for the selected nursery rhymes to validate possible sentiments from the lyrics. Acoustic feature values were extracted using the Jaudio tool. The sentiment scores obtained from the lyrics of nursery rhymes were used to select a matching rhyme for the children. Root mean square energy, tempo estimation, spectral centroid, and spectral bandwidth were selected as representative features of the audio features considering their possible impact on sentiments. The lesser the values of these features are likely to create negative sentiments. Since the feature values have different ranges, feature normalization was applied to compute the sentimental value of the impact. Since the audio impact is the combination of all the features, the average value of all normalized features was considered as a representative value. Considering this value, the sentiments were mapped to either positive or negative.

The following example explains the methodology used. Table 2 shows an example of one song 'Bye baby bunting'. The first row shows values obtained for the song using acoustic features extracted for respective features. Subsequent rows with average, minimum, maximum and maximum-minimum are considering values for all 50 songs and their feature values. As can be seen, the range of different feature values is different. Further, the values were normalized using mean normalization equation 1.

$$X' = (x - \text{average}) / (\max - \min). \quad (1)$$

Further to provide equal importance to RMSE, tempo and spectral feature, an average of 3 spectral feature values was considered to find the normalized average value. This is shown in table 3. If this value is negative, the sentiment was estimated as negative and sentiment will be estimated as positive in case the normalized average is positive.

Table 2. Acoustic feature extraction for nursery rhymes with example rhyme

Description	RMSE	Tempo Estimate	Spectral Centroid	Spectral Bandwidth	Spectral Rolloff
Bye baby bunting	0.152605	80.74951	2237.033	2391.89	4307.537
Average Value	0.130783	117.3357	2126.887	2230.75	4330.428
Maximum Value	0.04739	80.74951	1058.079	1539.642	2098.612
Minimum Value	0.305933	172.2656	2952.913	2948.355	6307.766
Max-Min Value	0.258543	91.51609	1894.834	1408.713	4209.154
Normalized Values	0.084404	-0.39978	0.05813	0.114388	-0.00544

Table 3. Sentiment prediction from acoustic features

RMSE	Tempo Estimate	Spectral Average	Normalized Average	Sentiment Estimation
0.084404	-0.39978	0.055693	-0.08656	Negative

3.3. Musical Interactions

In this experiment, the contextual sentimental information was extracted using the multimodal approach and was classified into positive, negative and neutral sentiments. Positive and negative sentiment songs were used for musical interactions. The outcomes were tested according to the response of the children for specific classes.The listener's response was crucial as the objective was to test specific behavioral changes in children.

The duration decided for the experiments was initially 3 months and we requested parents and school teachers to note the changes in the behavior of children with the help of checklist prepared. It was decided that parents will enjoy the selected rhymes along with children, thrice a week about 10 to 15 minutes per session. This duration and frequency were decided considering the convenience of parents and the attention span of children. This has resulted in about 30 such interactions in 3 months. Music interactions involve listening to nursery rhymes by the children. During the listening process, children were free to act or imitate their parents' actions or sing along with them. Full freedom was provided to children and parents to make the interaction lively and interesting.

Personal meetings were conducted with parents and teachers during the experiments to verify and modify the methodology if required. First meeting before experiments, the second after 1 month and the third after 3 months were conducted with individual parents in a closed-door environment. During the first meeting before starting the experiments, audio clips were handed over to the parents and the discussions were carried out about the conduction of experiments. Considering the busy schedule of individual parents, the plan was decided with appropriate time slots for the exposure of music to children. It was also verified that the children should be attentive and fresh for the session. It was decided that the parents and

teachers should note changes in the behavior, number of times with small narration of the incident and observations.

During the second meeting at the end of the first month, it was observed that all parents were excited and shared the behavioral changes observed. Although the recommendation was about 3 sessions per week, some parents had more than 3 in some weeks and few parents could manage 2 sessions in one/two weeks. Parent involvement was proposed during the first month and most of the sessions were conducted with active involvement by parents with children. After the first month, parent involvement was made optional and it was suggested to observe the children from a distance in such a case while listening to music.

After 3 months, during the last meeting, the feedback and observations were collected along with a discussion about the overall experience and outcome. A separate meeting with parents and teachers was useful in collecting impartial feedback about the children. The collected quantitative and qualitative data were analyzed to understand the results of the musical interactions.

Following is the list of standard parameters used for observation of hyperactive and introvert children for behavioral change during experimentation.

Checklist for hyperactive child behavioral change standard parameters

- ✓ Aggressive behavior in a specific situation is reduced/ not observed
- ✓ Give attention while instructions/ talk
- ✓ Follow instructions in the proper manner
- ✓ Stay sited to do some task for an expected time frame
- ✓ Patience in any situation i.e. waits for the arrival of the food or bus etc.
- ✓ Does not talk too much/ unnecessary to attract attention
- ✓ Does not distract/ interrupt others
- ✓ Give a thought before action or acting in any situation / does not lose temper
- ✓ Can concentrate for a longer time
- ✓ Reduced carelessness and more organized

Checklist for introvert child behavioral change standard parameters

- ✓ Improved response in situation/ talk
- ✓ Participation in group activity/ social gatherings
- ✓ Increased communication, i.e. more talkative/ Initiate communication
- ✓ Improved interaction with peers/ family members
- ✓ More confident
- ✓ Express emotions
- ✓ Spell out needs
- ✓ Enjoy in group
- ✓ Make new connections/friends
- ✓ Improved physical activities like sports, moments instead of sitting at one place

4. Results

The feedbackfrom the parents and teachers collected in the form of behavior change (BC) is considered as an important parameter which is measured as a number of times BC observed per month. The number of sessions in the presence of parents (with involvement) and in the absence of parents (No involvement with an observation from a distance) were noted in each month. Table 4 provides monthly data for Children related to musical interaction sessions conducted by parents. The first 3 children (K1, K2, and K3) were hyperactive and exposed to negative sentiment rhymes and the next 3 children (K4, K5, and K6) were introvertedchildren exposed to positive sentiment rhymes. There is no direct relation between a number of sessions and the number of times BC was observed.

Table 4. Monthly total sessions(S), in presence with direct involvement (I) and distant observation with no active involvement (NI) during the session

		Month1			Month2			Month3	
Children	**S**	**I**	**NI**	**S**	**I**	**NI**	**S**	**I**	**NI**
K1	10	10	0	12	6	6	8	2	6
K2	12	9	3	15	5	10	11	4	7
K3	9	6	3	8	0	8	10	5	5
K4	15	15	0	12	8	4	9	5	4
K5	11	9	2	9	3	6	6	2	4
K6	12	10	2	10	4	6	7	2	5

The feedback from the parents and teachers collected as notice of behavior change (BC) is a measure of statistical significance with quantitative analysis. The observations noted by parents and teachers with BC were useful for conclusions about the experiments. Table 5 provides BC noted by teachers and parents in each month as per the children involved.

Table 5. A number of behavioral changes noticed by teachers (BCT) and parents (BCP) on a monthly basis and an overall improvement in percentage.

	Month 1		Month 2		Month 3		Overall Improvement	
Children	**BCT**	**BCP**	**BCT**	**BCP**	**BCT**	**BCP**	**Teacher**	**Parent**
K1	2	3	1	2	3	3	25	30
K2	3	4	2	3	3	4	30	40
K3	1	2	2	2	1	3	20	30
K4	2	2	3	4	3	5	30	40
K5	1	1	2	3	2	2	20	25
K6	2	1	2	2	3	3	25	25

As can be noticed from Table 5, behavioral changes were noticed by both parents and teachers in each month during the observation period of 3 months. Overall improvement for all children was in the range of 20 to 40 % and it indicates the experiments have made an impact on the behavior of the children. The resulting statistics support the argument that musical interactive sessions have helped the children to improve their conduct.

A few general observations noted from the discussions with parents were as follows.

1. The children enjoyed music more in the presence of parents.
2. They liked few songs and could anticipate the song in later sections with responding before starting the song during subsequent sessions.
3. In the third month, children were not as attentive as at the beginning of the experiments.
4. Musical interactive sessions were useful for the children and helped them in improving behavior.

Some specific observations noted by individual parents were specific to the child and some interesting notes were as follows.

- One child was not responding initially, but later on, started responding during the sessions and the need for more such sessions may help as mentioned by the parents.

- One child was bored during the third month and parents tried changing the sequence of songs which helped to a certain extent; however, parents expressed the need for different songs to retain the interest of the children.
- One child shown tremendous improvement after sessions and the possible reason cited was quality time in the presence of parents during the musical interactions.

It was decided unanimously to continue the sessions in the 4th month without the involvement of parents and possible changes in the order of songs to keep the interest alive for the children who may have lost interest. Similar observations were noted in the last month with sessions and improvement in one month.

Table 6. A number of behavioral changes noticed by teachers (BCT) and parents (BCP).

		Month 4		Overall Improvement	
Children	**Sessions**	**BCT**	**BCP**	**Teacher**	**Parent**
K1	8	2	3	20	20
K2	10	2	4	20	30
K3	9	1	3	5	15
K4	8	3	3	20	20
K5	7	1	1	10	10
K6	9	2	2	20	25

From table 6, it can be observed that the sessions were effective in the improvement of the children. The average improvement noticed by teachers and parents was 15.83 and 20 percent respectively in the 4th month. The results clearly indicate that our hypothesis has strong evidential support considering the improvement noticed by parents and teachers for all children under observation. Music interaction with 9 rhymes selected for each group helped to improve conduct with varied average improvement noticed among children.

5. Discussion

The hypothesis as opposite sentiment rhymes can help children to balance the behavior is validated considering the results. As per the discussions with parents, the sessions have helped them to improve relations with the children and probably this increase in contact is also influential in the changed behavior of the children. It is difficult to measure it separately from the initial set of experiments planned. The findings of the experiments definitely support the argument that the kind of music played has an impact on the change of behavior. In the third month, most of the sessions were conducted with no active involvement and for the fourth month, sessions were planned exclusively without any involvement of parents to isolate the possible effect of involvement. As noticed, some children respondedbetter as compared to others with varied responsesto the individual level.

The children with less response were not much responsive to the rhymes and their liking was probably for different rhymes. The discussions with parents and teachers were very useful to understand the impact of musical interactions and provided great learning for everyone. Possible future directions could be using a different set of rhymes considering the likes of the children and the use of rhyme videos instead of only audios. Sympathy is the essential factor and specific songs help to change emotional states and in turn, help to improve the overall behavior. Different directions for future experiments are proposed to measure the impact of musical interactions like the use of controlled groups or the use of interactive videos, etc. The dataset of 50 nursery rhymeswith multimodal sentiment analysis and codes used is available in

the public domain for other researchers to explore more and make use of it [40]. Further research will enhance the knowledge and understanding of the impact of musical interactions related to children and their conduct.Current initial experiments with 3 children in each category have shown improved behavior. Observer's qualitative and quantitative feedback about the outcome is strong evidence that the experiments were useful in improving behavior. This study provides motivation to researchers in similar domains to perform similar such experiments.

Funding: This research received no external funding

Acknowledgments: We took essential approval from the institute, parents and teachers with the non-disclosure agreement. We took necessary permission and help from a child psychologist advisor associated with the school in designing and conducting the experiment. We have involved all stakeholders in the decision-making process and advised the parents accordingly. We acknowledge the support and help extended by parents, teachers and child psychologist advisors for performing experiments and children for musical interactions.

Conflicts of Interest: The authors declare no conflict of interest

References

1. *Child development article: https://www.mentalhelp.net/articles/sigmund-freud-and-child-development/(Accessed 25th April 2020).*
2. *Barnett WS. Long-term effects of early childhood programs on cognitive and school outcomes. The future of children. 1995 Dec 1:25-50.*
3. *Child development theories: https://www.verywellmind.com/child-development-theories-2795068 (Accessed 25th April 2020).*
4. *Jackson, N. A. (2003). A survey of music therapy methods and their role in the treatment of early elementary school children with ADHD.*
5. *Rickson, D. J. (2006). Instructional and improvisational models of music therapy with adolescents who have attention deficit hyperactivity disorder (ADHD): A comparison of the effects on motor impulsivity. Journal of Music Therapy, 43(1), 39-62.*
6. *Zhang, F., Liu, K., An, P., You, C., Liu, Q., & Teng, L. (2017). Music therapy for attention deficit hyperactivity disorder (ADHD) in children and adolescents. The Cochrane database of systematic reviews, 2017(5).*
7. *Hogenes, M., Oers, B. V., & Diekstra, R. F. (2014). The impact of music on child functioning. The European Journal of Social & Behavioural Sciences, 10(3), 1507-1526.*
8. *Helgoe, L. A. (2013). Introvert power: Why your inner life is your hidden strength. Sourcebooks, Inc..*
9. *Furnham, A., & Allass, K. (1999). The influence of musical distraction of varying complexity on the cognitive performance of extroverts and introverts. European Journal of Personality, 13(1), 27-38.*
10. *Mistry, H. (2015). Music while you work: the effects of background music on test performance amongst extroverts and introverts. Journal of Applied Psychology and Social Science, 1(1), 1-14.*
11. *Kopacz, M. (2005). Personality and music preferences: The influence of personality traits on preferences regarding musical elements. Journal of Music Therapy, 42(3), 216-239.*
12. *Schäfer, T., & Mehlhorn, C. (2017). Can personality traits predict musical style preferences? A meta-analysis. Personality and Individual Differences, 116, 265-273.*
13. *Nugent, J. (2019). Music Therapy with Children with Autistic Spectrum Conditions and Their Families. Music Therapy and Autism across the Lifespan: A Spectrum of Approaches, 179.*

14. *Shi, Z. M., Lin, G. H., & Xie, Q. (2016). Effects of music therapy on mood, language, behavior, and social skills in children with autism: A meta-analysis. Chinese Nursing Research, 3(3), 137-141.*
15. *Ettenberger, M., Rojas Cárdenas, C., Parker, M., & Odell-Miller, H. (2017). Family-centred music therapy with preterm infants and their parents in the neonatal intensive care unit (NICU) in Colombia–a mixed-methods study. Nordic Journal of Music Therapy, 26(3), 207-234.*
16. *Yau, K. C., & Fachner, J. (2019). Effects of motifs in music therapy on the attention of children with externalizing behavior problems. Psychology of Music, 0305735619880292.*
17. *Wang, Z., Li, Z., Xie, J., Wang, T., Yu, C., & An, N. (2018). Music therapy improves cognitive function and behavior in patients with moderate Alzheimer's disease. International Journal of Clinical and Experimental Medicine, 11(5), 4808-4814.*
18. *Ehrlin A, Gustavsson HO. (2015). The Importance of Music in Preschool Education. Australian Journal of Teacher Education. Jul;40(7):n7.*
19. *Hilliard RE. (2001). The effects of music therapy-based bereavement groups on mood and behavior of grieving children: A pilot study. Journal of Music Therapy. Dec 1;38(4):291-306.*
20. *Hallam S. (2010). The power of music: Its impact on the intellectual, social and personal development of children and young people. International Journal of Music Education. Aug;28(3):269-89.*
21. *Mullen G. (2017). More Than Words: Using Nursery Rhymes and Songs to Support Domains of Child Development. Journal of Childhood Studies. Sep 27;42(2):42-53.*
22. *Cardanay, A. B.(2013). Nursery rhymes in music and language literacy. General Music Today, 26, 30–36. http://dx.doi. org/10.1177/1048371312462869*
23. *Cobb, J. (2007) What'll I do with the baby-o? Nursery rhymes, songs, and stories for babies. Vancouver, BC: Blacksheep Press.*
24. *Kenney S. (2005). Nursery rhyme foundation for learning. General Music Today. Oct;19(1):28-31.*
25. *Velankar, M. R., &Sahasrabuddhe, H. V. (2012, December). A pilot study of Hindustani music sentiments. In Proceedings of the 2nd Workshop on Sentiment Analysis where AI meets Psychology (pp. 91-98).*
26. *Makarand V., Kulkarni Parag (2019). Music emotion recognition for film music, International Society of music information retrieval (ISMIR 2019) LBD session.*
27. *Hu X, Downie JS, Ehmann AF. (2009). Lyric text mining in music mood classification. American music. Oct;183(5,049):2-09.*
28. *Hu X, Downie JS. (2010). Improving mood classification in music digital libraries by combining lyrics and audio. InProceedings of the 10th annual joint conference on Digital libraries (pp. 159-168). ACM.*
29. *Patra BG, Das D, Bandyopadhyay S. (2013). Automatic music mood classification of Hindi songs. InProceedings of the 3rd Workshop on Sentiment Analysis where AI meets Psychology (pp. 24-28).*
30. *Hu X, Choi K, Downie JS. (2017). A framework for evaluating multimodal music mood classification. Journal of the Association for Information Science and Technology. Feb;68(2):273-85.*
31. *Abburi H, Akkireddy ES, Gangashetti S, Mamidi R. (2016). Multimodal Sentiment Analysis of Telugu Songs. InSAAIP@ IJCAI Jul 10 (pp. 48-52).*
32. *Hu X, Downie JS, Ehmann AF. (2009). Lyric text mining in music mood classification. American music. Oct; 183(5,049):2-09.*
33. *Hasan A, Moin S, Karim A, Shamshirband S. (2018). Machine learning-based sentiment analysis for twitter accounts. Mathematical and Computational Applications. Mar;23(1):11.*

34. *Giatsoglou M, Vozalis MG, Diamantaras K, Vakali A, Sarigiannidis G, Chatzisavvas KC. (2017). Sentiment analysis leveraging emotions and word embeddings. Expert Systems with Applications. Mar 1;69:214-24.*
35. *Tran HN, Cambria E. (2018). Ensemble application of ELM and GPU for real-time multimodal sentiment analysis. Memetic Computing. Mar 1;10(1):3-13.*
36. *Lim HA, Draper E. (2011). The effects of music therapy incorporated with applied behavior analysis verbal behavior approach for children with autism spectrum disorders. Journal of music therapy. 1;48(4):532-50.*
37. *Rosenfield, N. S., Lamkin, K., Re, J., Day, K., Boyd, L., & Linstead, E. (2019). A Virtual Reality System for Practicing Conversation Skills for Children with Autism. Multimodal Technologies and Interaction, 3(28), 1-9.*
38. *Geipel, J., Koenig, J., Hillecke, T. K., Resch, F., & Kaess, M. (2018). Music-based interventions to reduce internalizing symptoms in children and adolescents: A meta-analysis. Journal of affective disorders, 225, 647-656.*
39. *Porter, S., McConnell, T., McLaughlin, K., Lynn, F., Cardwell, C., Braiden, H. J., ... & Clinician, L. (2017). Music therapy for children and adolescents with behavioural and emotional problems: A randomised controlled trial. Journal of Child Psychology and Psychiatry, 58(5), 586-594.*
40. *https://gitlab.com/mak/nursery-rhymes-analysis*
Dataset, result, and code available on the link