

Detecting an Infant's Developmental Reactions in Reviews on Picture Books

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Abstract

We extract the book reviews on picture books written on the Web site specialized in picture books, and found that those reviews reflect infants' behavioral expressions as well as their parents' reading activities in detail. Analysis of the reviews reveals that infants' reactions written on the reviews are coincident with the findings of developmental psychology concerning infants' behaviors. In order to examine how the stimuli of picture books induces varieties of infants' reactions, this paper proposes to detect an infant's developmental reactions in reviews on picture books and shows effectiveness of the proposed method through experimental evaluation.

1 Introduction

Generally, educational books focus on a specific subject to be learned such as science, sociology, etc. Picture books are exceptions, in terms of their efficiency for infants' cognitive developments (Pardeck, 1986) without any intention on specific educational subject with their style of expressions, i.e., funny stories and pictures. Additionally, picture books are outstanding in that those who read them are separated from those who perceive them. Readers are parents or child care persons who make book talks for infants who do not have sufficient literacy yet. Infants perceive and interpret incoming stimuli of the book talks and the pictures.

According to the research in the developmental psychology, infants are found to express variety of cognitive reactions to the external stimuli in accordance with their developmental stage. If picture

books work as those kinds of stimuli, infants might express the cognitive reactions when the stimuli of picture books are perceived. Furthermore, this tendency might be amplified, because infants are free from understanding the printing letters of picture books.

In order to examine how the stimuli of picture books induces varieties of infants' reactions, we take an approach of applying a text mining technique to a large amount of the reviews on picture books written by their parents or the childcare persons. More specifically, this paper proposes to detect an infant's developmental reactions in reviews on picture books and shows effectiveness of the proposed method through experimental evaluation. This paper is the first attempt to solve the task of detecting an infant's developmental reactions in reviews on picture books.

2 The Web Site specialized in Picture Books

To analyze the infants' reactions, text data of reviews on picture books are collected from EhonNavi¹, the web site specialized in picture books. EhonNavi provides with the information concerning picture books such as publishers, authors, outlines as well as a large amount of reviews written by the parents or child care persons, where the numbers of the titles of the picture books included in EhonNavi amount to about 55,600. The number of the reviews amount to approximately 290,000 as of January 2015 (shown in Table 1). Other than EhonNavi, popular Web sites

¹<http://www.ehonnavi>



Figure 1: An Example of a Review of "The Giant Turnip"

Table 1: Overview of EhonNavi

(a) Principal Information

Start date of the service	Number of titles	Number of unique users per month	Number of members	Number of reviews
Apr. 2002	55,600	1,055,000	343,000	289,000

(b) Distribution of the Numbers of Reviews according to Infants' Age

Age of infants	0	1	2	3	4	5
Number of reviews	7,272	13,450	22,448	25,795	21,573	18,143

Table 2: Categorization of Descriptions in Reviews

Categories		Explanation	Frequency in 345 reviews of 16 titles
Reviewers' reactions	impressions / critiques	Reviewers' impressions and / or critiques on the picture books	177
	retrospection in their ages of infants	Reviewers' retrospective descriptions reflecting their own reactions when they were in their infants' ages	11
	performance of reading	Performance such as gestures and change of voice tones for attracting the infants' attentions when reading	33
	expectation of infants' reactions	Reviewers' expectations and concerns about how the picture book affect to their infants	177
Infants' reactions		Infants' reactions to reviewers' reading of the picture books	276
Description of the story		Description of the scenes, stories, and the characters of the picture books	147

with a large amount of book reviews include Amazon² and Booklog³. Out of them, EhonNavi has a unique characteristics in that its reviews tend to be elaborated, reflecting the reactions of those who make book talks as well as those who perceive them. Additionally, it is also the EhonNavi's characteristics that the age of the infant is attached to each review. All these characteristics are preferable for our work aiming at detecting the infants' reactions in accordance with their developmental stages. Therefore, we employ the reviews of EhonNavi for the analysis of this paper.

3 Categorization of Descriptions in Reviews

Figure 1 shows an example of the review of EhonNavi. As shown in the figure, the header of each review includes the age of the infant to whom the reviewer reads the picture book. As described above, reviews of EhonNavi include descriptions of book talkers' reactions, mixed with infants' reactions. Since reviewers are book talkers in all the cases, infants' reactions described in reviews are those observed by reviewers.

²<http://www.amazon.co.jp>

³<http://booklog.jp>

In order to categorize descriptions in reviews, we randomly picked up 345 reviews from 16 titles of picture books and manually classified descriptions in those reviews⁴. Table 2 shows the result of categorizing descriptions in reviews. Those descriptions are roughly categorized into reviewers' reactions, infants' reactions, and descriptions of the story. Reviewers' reactions are further sub-categorized as shown in the table⁵. In order to further sub-categorize infants' reactions, we refer to studies of developmental psychology. In those developmental psychology literatures, they present categories of infants' cognitive developments in accordance with their ages. Next section introduces those categories of infants' cognitive developments and analyze the reviews based on them.

⁴The first author of the paper worked on manually categorizing descriptions in reviews.

⁵Note that, since each review may include not only one type of reviewers' reactions but also other type of reviewers' reactions, or both of reviewers' and infants' reactions, etc., sum of the frequencies in 345 reviews of 16 titles is more than 345.

Table 3: Infants’ Reactions based on the Theory of Developmental Psychology and Typical Expressions

Characteristics of developmental reactions	Explanations and examples	Typical expressions	
		ID	expression
Reactions to visual stimuli	Showing an interest in the pictures especially the ones of foods. / Enjoy to find something in the pictures that are familiar to the infants.	1.	gaze at / stare hard / listen hard
Physical expressions mixed with verbal expressions	Pointing fingers and making gestures in case the infants are not able to express verbally. / Reaching for the things on the picture book as if they were the real things.	2.	point fingers
Pretend play	An example: If the infant is asked to hand something to his or her parents, he or she pretends to hand it to them even though it does not exist.	3.	pretend
Imitate	Imitating various things such as the persons, things, and the events surrounding the infant.	4.	imitate
Supposition	Finding common characteristics between real things and what are supposed to be.	5.	suppose
Reactions to repeating the same rhythm	Reacting to onomatopoeic words. / The infant repeats the onomatopoeic words because of their rhythmical sounds, though he or she does not understand what they mean.	6.	onomatopoeic words
Game of make-believe	Reproducing the story of the picture book based on such activities that the infant imagines himself/herself to be in the place in the picture book.	7.	game of make-believe
Interests in the relationship or the causality	Indicating intellectual curiosity by asking “why” frequently. / An example: “Does Papa read the newspaper because he works? Does Mama cook the dinner because she is a housewife?”	8.	“?” (question mark)
Empathy for the story	Emotionally being involved in the world depicted by the picture book. / An example: “If I could enter into the picture book, I would save the cat.”	9.	enter into
		10.	empathy

Table 4: Number of Analyzed Reviews per age (ages from 0 to 5)

age of infants	0	1	2	3	4	5	total
number of reviews	1,491	3,150	4,306	4,062	3,203	2,033	18,245

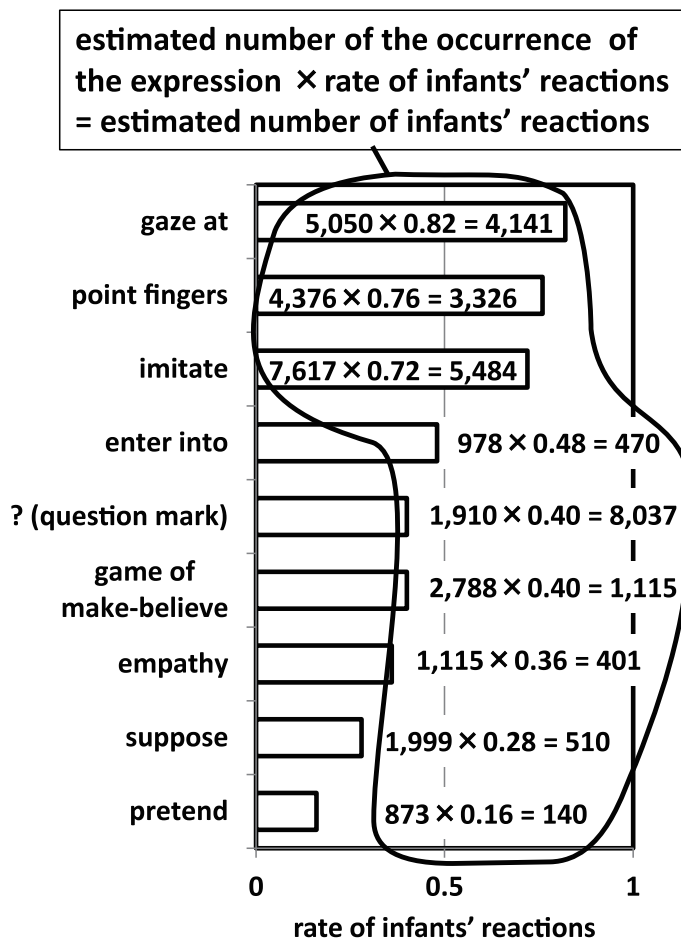


Figure 2: Estimating the Numbers of Infants' Developmental Reactions

4 Categorizing Infants' Reactions based on Developmental Psychology

According to the theory of developmental psychology, infants express age specific reactions to incoming stimuli. We collect such infants' reactions that are specific to ages ranging from 0 to 3 from publications or papers concerning developmental psychology (Sully, 2000; Piaget, 1962; Leslie, 1987; Walker-Andrews and Kahana-Kalman, 1999) and list them in Table 3. In this table, we list those 10 types of reactions in the order of from those observed in the early age 0 to those observed in the later age 3. This result indicates that infants at their very early stage of ages tend to react automatically with their physical expression, such as pointing the fingers, or grasping gestures, meanwhile, those at their later stage of ages tend to react consecutively

expressing their intention, such as game of make-believe, or asking why, though some reactions are common over multiple ages.

Finally, we manually examine those randomly picked up 345 reviews from 16 titles of picture books examined in the previous section and collect typical expressions representing each of the 10 types of infants' reactions listed in Table 3. Collected expressions are shown on the right hand side column of Table 3.

5 Detecting an Infant's Developmental Reactions in Reviews

The underlying motivation of this paper is to develop a system for recommending picture books which might induce expected infants' reactions specified by the users. Considering this motivation, this section examines whether it is possible to detect an in-

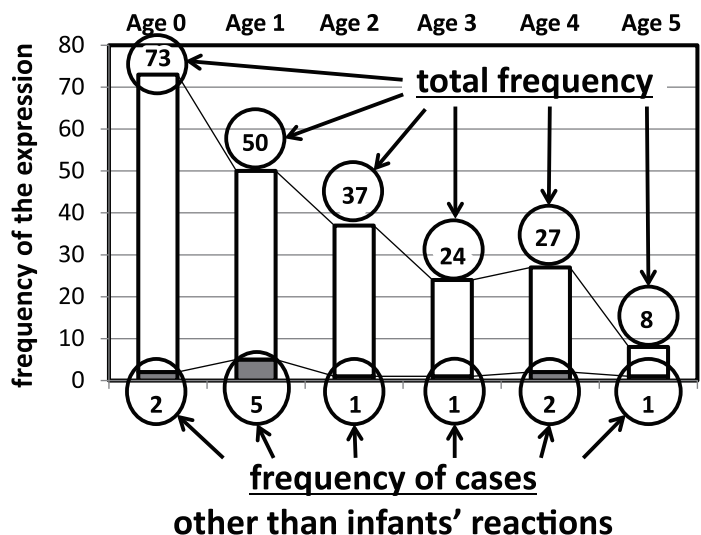


Figure 3: Frequency Distribution of Infants’ Reactions of the Expression per Age: “gaze at / stare hard / listen hard”

fant’s developmental reactions in reviews on picture books.

In order to select sample reviews for the analysis, we first collect titles of picture books which have sufficient number of reviews. Here, we rank picture books in descending order of the number of reviews and select the topmost 99 titles, where the total number of the reviews of those 99 titles amount to 27,661. Out of the total 27,661 reviews, we analyze those with infants of ages from 0 to 5 years old, which amount to 18,245 reviews, as shown in Table 4. Table 4 also shows the numbers of the analyzed reviews per age.

5.1 Estimating the Numbers of Infants’ Developmental Reactions

For most of the 10 types infants’ reactions as well as their typical expressions listed in Table 3, Figure 2 shows the rate of infants’ reactions within the occurrence of each expression as well as the estimated numbers of infants’ developmental reactions. For each of the 10 types of infants’ reactions, the rate of infants’ reactions within the occurrence of its typical expressions is measured by collecting the latest 20 reviews which include one of those typical expressions and then by manually examining whether each of their occurrences actually represents an infant’s developmental reaction or not.

Also, those estimated numbers of infants’ devel-

opmental reactions are calculated by measuring the number of the occurrence of the typical expressions listed in Table 3, and then by multiplying it by the rate of infants’ reactions within the occurrence of each expression.

As can be seen from this result, the rates of infants’ reactions are relatively low. In the next section, we propose to detect an infant’s developmental reactions with collocational expressions so that we can improve the rate of infants’ reactions.

5.2 Detecting an Infant’s Developmental Reactions in Reviews with Collocational Expressions

As typical expressions which represent infants’ developmental reactions and are suitable for the analysis of this paper, out of the 10 types infants’ reactions as well as their typical expressions listed in Table 3, we select “gaze at / stare hard / listen hard”, “imitate”, and “game of make-believe”. According to the studies in developmental psychology (Sully, 2000; Piaget, 1962; Leslie, 1987; Walker-Andrews and Kahana-Kalman, 1999), the infants’ reaction “gaze at / stare hard / listen hard” is mostly observed around the age of 1, “imitate” around that of 2, and “game of make-believe” around that of 3. Then, in order to detect an infant’s developmental reactions in reviews on picture books, we propose to collect collocations of each of those three expres-

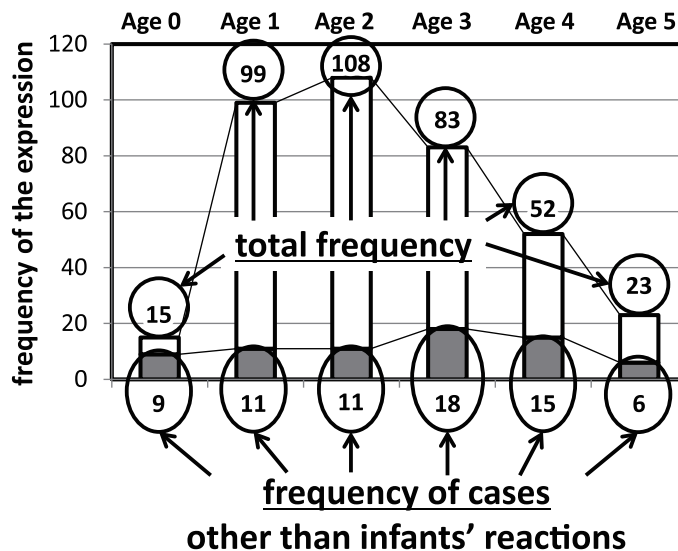


Figure 4: Frequency Distribution of Infants’ Reactions of the Expression per Age: “imitate”

sions as below and to detect an infant’s developmental reactions represented by those collocational expressions.

- For “gaze at / stare hard / listen hard”, we further add pronunciation variation of “gaze at / stare hard / listen hard” as well as expressions which are “gaze at / stare hard / listen hard” concatenated with the object “the picture book”.
- For “imitate”, we collect “imitate to eat”, “imitate and”, and “imitation of”.
- For “game of make-believe”, we collect “make-believe play” and “train games”.

For each of the three expressions “gaze at / stare hard / listen hard”, “imitate”, and “game of make-believe”, Figure 3 to Figure 5 show frequency distribution of infants’ reactions per age. In these figures, total frequencies of those with collocational expressions as well as frequencies of cases other than infants’ reactions are shown. Those frequencies are counted by manually judging several hundreds matched expressions. From these results, we measure rates of correctly detecting infants’ developmental reactions, which are 94% (“gaze at / stare hard / listen hard”), 77% (“imitate”), and 70% (“game of make-believe”). Thus, it is quite possi-

ble to detect an infant’s developmental reactions in reviews on picture books with fairly high precision.

Moreover, out of all the occurrences of each of the expressions “gaze at / stare hard / listen hard”, “imitate”, and “game of make-believe”, we examine how many of them are actually covered by the collected collocational expressions. We found that those with the collected collocational expressions cover about 50% (“gaze at / stare hard / listen hard”), 60% (“imitate”), and 66% (“game of make-believe”) of their occurrences. Thus, those collected collocational expressions cover fairly large amount of occurrences. Finally, as clearly shown in this result, expressions appearing in reviews of EhonNavi represent infants’ reactions in the way coincident with respective age specific reactions asserted by developmental psychology.

6 Conclusion

In order to examine how the stimuli of picture books induces varieties of infants’ reactions, this paper proposed to detect an infant’s developmental reactions in reviews on picture books and showed effectiveness of the proposed method through experimental evaluation. Future work includes developing a framework of recommending picture books which accepts the age of an infant and an expected developmental reaction as its input, and as its output, gives a list of picture books that are ranked according to

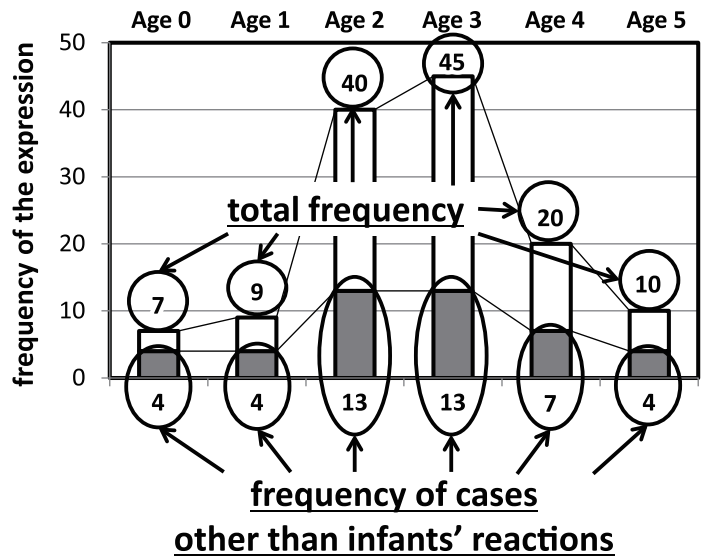


Figure 5: Frequency Distribution of Infants' Reactions of the Expression per Age: "game of make-believe"

the degree of expected developmental reactions by infants.

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