

Effects of children characteristics on sound environment in fast food restaurants in China

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Summary

Fast food restaurants often contain playgrounds for children. This study explores how various characteristics of children, including their number, ages and gender, affect the sound pressure level (SPL). Field surveys were performed at a KFC in Harbin city, China. The results show that the SPL can be increased with increasing number of children. When the number of children is less than 4, and the main group is united, the SPL can be increased by 3.9 dB per person, while when the number of children is more than 7, and the main group is independent, the SPL fluctuates with 1.3 dB/person. It is interesting to note that different combined groups of children's playing and different combinations of gender can affect SPL effectively. For instance, when the field is full of girls, the sound pressure level will be increased generally 2 dB compared to a field full of boys and girls.

Keywords: Children; fast food restaurant; sound environment; playground

1. Introduction

A fast food restaurant, also known as a quick service restaurant (QSR) within the industry, is a specific type of restaurant that serves fast food cuisine and has minimal table service [1]. The food served in fast food restaurants is typically part of a 'meat-sweet diet', offered from a limited menu, cooked in bulk in advance and kept hot, finished and packaged to order, and usually available for take away, though seating may be provided [2]. Some previous studies have pointed out that the users' eating behaviours as well as their length of eating, in fast food restaurants can be affected by sound environment [3]. Some of them pointed out that different types of restaurants may lead to different kinds of acoustic environments [4]. Another study indicated that the income of restaurants may be increased with some type of background music [5]. On the other hand, the

increasing of equipment noise, such as lampblack machines or fans can decrease eating length of customers in these restaurants [6]. Acoustic perception of users may be affected by different kinds of dining styles in restaurants [7]. Some studies have shown that the subjective loudness in the fast food restaurants can be increased with the increasing of crowd density, while the acoustic comfort can be decreased with increasing of crowd density [8].

Playgrounds were added in fast food restaurants in recent years [9]. With the development of 'one-stop consumption', to attract children and their families consuming in these places [10], some fast food restaurants in shopping malls added playgrounds, with slides, playhouses, or mazes. On the one hand, children aged 3-6 years have the characteristics of having a love of communication [11]. At the same time, they may make noise when they are playing

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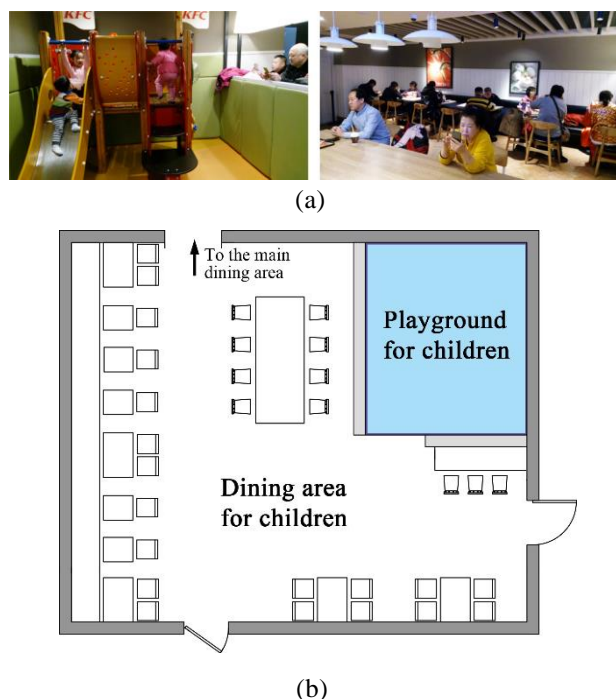


Figure 1. The plan of the location of the playground for children: (a) the playground for children and some tables in this area for children and their families; (b) the plan of the area which contains the playground.

in the playground. It can be seen from these characteristics that the sound made by children is an important constituent of the acoustic environment in the fast food restaurant. However, the issue of how the sound pressure level can be affected by various characteristics of children, including combined styles of play and number and gender of children, has not been addressed in previous studies.

Therefore, in the present study, a typical fast food restaurant in China was selected as the case study site, and the sound level measurements and some behaviours of children were investigated to find out if the sound pressure level can be changed by playing groups, as well as by number or gender of children.

2. Methodology

2.1. Case study site

Some studies pointed out that the area of fast food restaurants is related to population density [12]. It is indicated that in most cities of China the area is generally in the range of 100 m²-250 m². The playground for children accounts for 1/10-1/16 of the total area. At the border of the playground, there is a 1.2-meter-high fence to separate it from the dining area for children and their families (*Fig.1a*).

A typical Kentucky Fried Chicken (KFC) named Jianyi restaurant was chosen in the present study. It is located in Daoli district, Harbin city, in China. The area of the case study site is 200 m², a typical size according to current studies. The indoor space of the restaurant was divided into two parts by furniture—the semi-enclosed area containing some tables and the playground for children—in order to keep the playground and children's dining area away from the main dining area which can provide a safe and convenient environment for children and their families. The space is rectangular, 70 m² in total size, and the area of the playground for children is 14 m², generally 1/5 of it. There are 13 tables, which contains 33-40 people, in case study site (*Fig.1b*). In the case site, the interior materials of ceilings, walls, and floors can be seen from *Table I*.


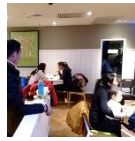
2.2. Investigation of children's behaviours

For measurements, an HD video camera was used to record behaviours of children when they were playing in the playground. Measurements were performed from 10 o'clock to 16 o'clock. The reason for using this period of time is because it is most likely time for children to play in the playground. Children between 3-6 years were investigated in this study, since for safety reasons, most playgrounds are open to children over 3 years old, and most children are no more than 6 years old in the playground. Previous studies have pointed out that children from 3 years to 6 years are the ones who most like playing in the playground [13].

It is found that the behaviour of children in the field is unstable for a period of time when children enter or leave the playground, and the instability usually disappears after one minute, when the newly arrived child becomes familiar with the environment and begins to play. So, the starting point of the observation is set to 1 minute after the change in the number of children in the playground. It can be found that the behaviour of children was stable for 8-10 minutes, beyond which there would be some changes. Therefore, five minutes of continuous observation is chosen as the time of a set of data, which can ensure the stability of children's behaviour in the measurement period.

There are some cases in the 5-minute measurement. In the course of the observation, if a child runs out of the playground but he is not separated from the activities in the playground, the measurement will continue; if a child runs out of the playground and gets out of the activity the measurement will stop

Table I. Interior materials of ceilings, walls, and floors in the case site

		<i>The playground</i>	<i>The dining area</i>
<i>Photograph</i>			
<i>Interior materials</i>	<i>Ceilings</i>	<i>Gypsum</i>	<i>Gypsum</i>
	<i>Walls</i>	<i>Soft pack</i>	<i>Plaster and plastic</i>
	<i>Floors</i>	<i>PVC</i>	<i>KFC tail</i>

and the measured data will not be considered valid. The video recorded combined groups of playing, number and gender of children. The number of children in the playground is likely to change at any time, so the data selected for analysis were chosen to meet the above conditions.

2.3. Measurements of Sound level

The measurement of the sound pressure level starts at the same time as the observation of children's behaviour in the field. The measurement of the sound pressure level begins at the beginning of the observation, ends at the end of the observation, and reads data every 10 seconds in the measurement [14]. An 801 sound-level meter was set 1 m from the wall and main reflectors and 1.2-1.5 m from the ground with slow-style [15] and A-weight.

3. Results

This section introduces the play groups of children (3.1), effects of different combined groups of playing (3.2), and different number (3.3) and gender (3.4) of children on the sound pressure levels.

3.1. Play groups of children

Three play groups of children have been found in the observation which are united, partly independent, and independent (*Table II*). *United* group means when children were playing they could form an obvious group in the playground. *Partly independent* group means some children formed a group and the other children just played with themselves and had no communication with others. *Independent* group means every child play alone and there was no group in the playground. A previous study showed that there are four styles when a child contacts others which include contact with partners and contact with himself [16]. The

possibility of the existence of three combined styles is proved by this.

United group mainly occurs when the number of children is small (usually less than 3). When the number is large (usually more than 4), the group of combination will gradually change from united to partly independent or even independent with the increasing number of children. But the relationship between the group and the number of children is not absolute. When the number is *small*, sometimes there exists independent group. When the number is *large*, there is usually no complete united group. According to different actions, there exist three ways of children's contact: individual, group, and community [17]. This study further confirms that these three combined groups are not accidental.

It can be seen in *Fig.2* that the trends of the three combined groups vary with the number of children. United group mainly appears when the number of children is 2-3, with 64.29%-76.92%. The percentage of united drops rapidly as the number of children increases. Partly independent group exists when the number of children is between 4 and 8. The proportion of this combined group first increased and then decreased, showing a parabola trend. Independent group exists in all conditions. Its proportion is increased with the increase of the number of children in most conditions. The causes of these phenomena are mainly related to the age characteristics of children. When the number of children is small, it is easy to form effective communication between children, which is the premise of forming the united group. The language and organizational skills of children aged 3-6 are just beginning to develop [11], which means children can have difficulty organizing all the children in the playground to play together in the united group when the number of children is larger. This will result in the united group being replaced by two other groups. It can be found in observing that there is almost no communication, or just

Table II. Take 4 children in the playground as example shows three combined styles of children's playing.

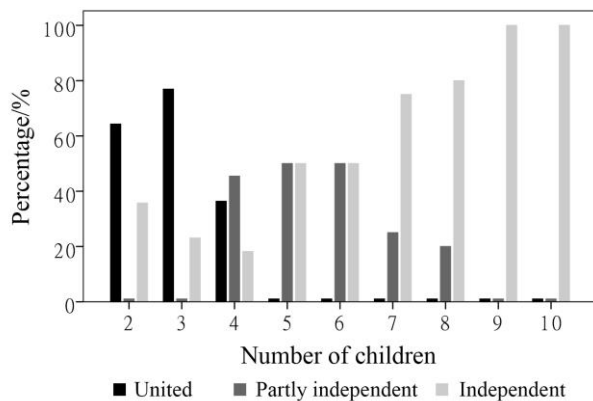
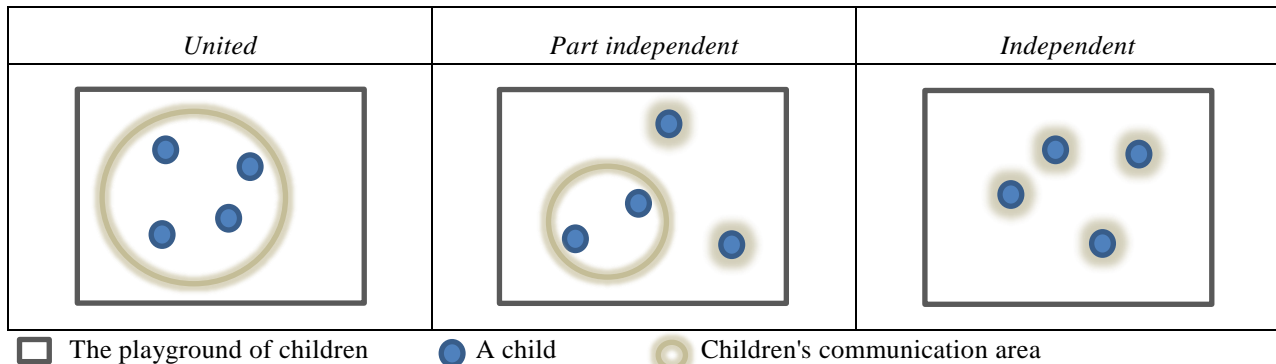


Figure 2. Influence of increasing number of children on combined group of playing.

nonverbal communication, between children when the number is large [18]. This way of communication also makes it difficult for children to form an obvious group to play. What is worth paying attention to is that when the number of children is 3, the partly independent group which is supposed to exist is not actually observed, and the proportion of the united group is 53.84% higher than the independent group. In observing when two children play together, the third child is very likely to join them. This kind of companionship can effectively reduce the loneliness of children [19].

3.2. Effect of play groups

Taking the 4 children as an example, it can be seen from Fig.3 that the sound pressure level of united group is the max with 79.5 dB, and in partly independent group it is 3.4 dB lower. The min sound pressure level is independent group with 74.5 dB. The reason for this phenomenon is that the sound pressure level of communication is different in every combined group. Children need to communicate with others in order to form a group of united, and there will always exist language communication after the group is formed. The

sound pressure level of language communication may be increased with the increasing of children's interests in playing. There is little to no language communication when the group is independent which may be related to the developing stage of language ability of children of this age. In this stage, they cannot initiate communication successfully, but they can keep communication by non-language interacting with others [20].

3.3. Effect of number of children

Fig.4 shows the relationship between number of children and average sound pressure level with regression analysis and coefficient of determination R^2 . Linear, quadratic and cubic are used to determine a regression curve that is most suitable to express the relationship between the number of children and the sound pressure level. The dot line is linear, the chain line is quadratic, and the solid line is cubic. It can be seen from the figure that the cubic curve is the best fit, with $R^2=0.991$.

When there are no children in the playground, the sound pressure level is generally 65.4 dB, which is the same as when there is only one child in the playground. It shows that there was no significant difference found between the sound pressure level and the number of children when there is only one child or no children in the playground, with T-test, $p>0.1$.

According to the trend in Fig.4 when the number of children is more than 1, the sound pressure level can be increased with increasing of the number of children. The sound pressure level showed an increasing trend with average increase of 3.9 dB per child when the number of children is between 2 and 4. The reason for this phenomenon is that the main combined group is united in this stage. With the increase in the number of children, more and more children are joining in to communicate with others.

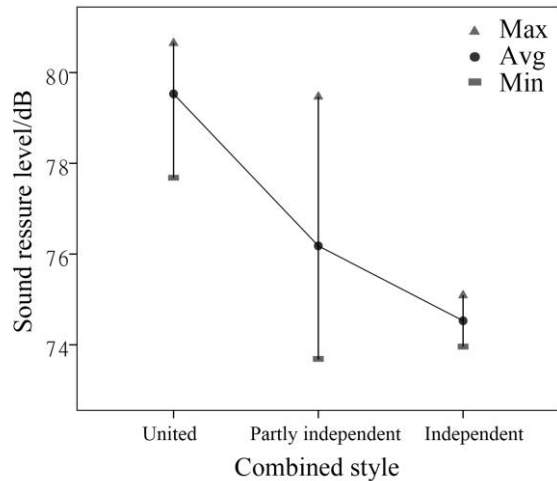


Figure 3. Relationship between combined styles of playing and sound pressure level, taking 4 children in the playground as an example.

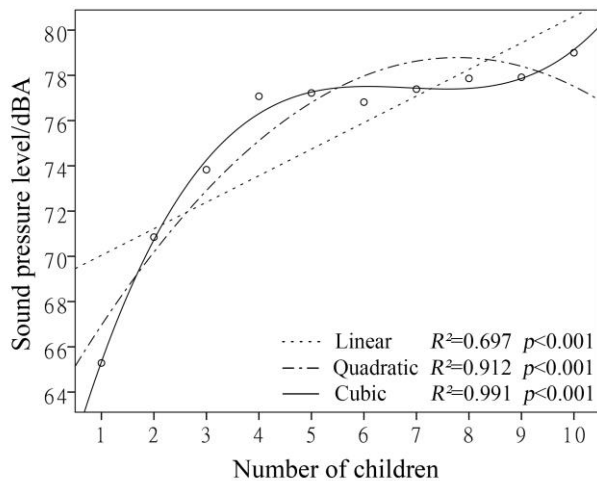


Figure 4. Relationship between number of children and average sound pressure level with regression analysis and coefficient of determination R^2 , at $p < 0.001$.

Linear: $y = 68.87 + 1.173x$, $R^2 = 0.697$

Quadratic: $y = 63.205 + 4.006x - 0.258x^2$, $R^2 = 0.912$

Cubic: $y = 57.689 + 8.898x - 1.318x^2 + 0.064x^3$, $R^2 = 0.991$

So the trend of communication between children increases. At the same time, the sound of the communication may also increase. This phenomenon of increased communication is a benefit for children's development. Studies have shown that playing with different partners and communicating with adults other than parents can develop children's social skills which will have an impact on children's development [21].

Within the range of 4 - 7, average sound pressure level is 77.1 dB with a fluctuating range of 76.8 dB-77.4 dB. There is no significant difference between the increase in the number and the change in the

sound pressure level with mean difference T-test, $p > 0.1$. The reason for this phenomenon is related to the change in the combined group of children's playing. When there are less than 4 children, it is easy to form a united group with 65% possibilities; when the number is more than 4, the original stable group may be destroyed and replaced by forming a partly independent group or even forming an independent group with a possibility of 17% (Fig.3). Changing in the combined group results of the sound pressure level cannot be increased with the increase of the number of children.

When the number of children is in the range of 7-10, the sound pressure level increases 1.3 dB on average for each additional child. This rate of increasing is significantly less than when the number is less than 4 (3.9 dB per person). But the average sound pressure level is 78.6dB, which is larger than when the number is no more than 4 (71.8 dB). This phenomenon is due to the fact that when the number is large, there is a 72% possibility for it to form an independent group. It is much less likely that the group will form a partly independent group, and it rarely forms a united group, which makes an obvious decrease in sound of communication compared with when the number was small. Since the overall sound is loud, some parents maintain order from time to time so the average sound pressure level shows an increasing trend.

The process of the sound pressure level changes with the number of children shows such a trend: the sound pressure level is increased quickly with the increase in the number of children when there are no more than 4 children; no significant change can be found in the sound pressure level when the number is between 4 and 7; when the number is more than 7, the sound pressure level is raised slowly with the increasing of the number. Overall, changes in the sound pressure level are associated with changes in the number of children in the playground.

3.4. Effect of gender

When the number of children is fixed, the different number between boys and girls obviously influences the sound pressure level. When the number of children is 1 or 2, there is no such situation that both boys and girls exist and the numbers of them have significant difference in quantity. So these cases were not within the scope of discussion. Taking the number of 4 as an

example, it can be seen that the average sound pressure level is 77.1dB (*Fig.5*).

When the field is full of girls or boys, the sound pressure level is increased and decreased by an average of 2dB. At the same time, the average sound pressure level of the former (77.6 dB) is 3.1dB higher than that of the latter. Girls' sound has more high-frequency sound than boys' and the A weighted is used in the measurement, so it shows the phenomenon described above. If boys and girls both exist, the changing range of the sound pressure level can be obviously larger. When the number of boys is the same as that of girls or it is larger than that of girls, the sound pressure level can fluctuate between 73.9 dB and 78.4 dB. When the number of girls is more than that of boys, the fluctuant range of the sound pressure level is 70.0 dB-80.6 dB, which is obviously larger than that of other cases (*Fig.5*). In the observation, it can be found that the cause of the wide range of the sound pressure level may be related to girls. In this case, sometimes girls barely make any noise; sometimes the frequency and the sound made by the girls, whether it is their own sound or the sound they communicate with their partner, is higher than that in other cases. So the sound pressure level was fluctuated. At this time, the girls showed higher social skills than boys. It is possible for boys to improve their social skills when they are active in such places.

The results show that only girls in the playground can make the sound pressure level higher than only boys there. When the number of girls is higher than that of boys, it has the greatest influence on fluctuant range of the sound pressure level.

4. Conclusion

Based on the measurement and observation, the influence of children's characteristics on sound environment in fast food restaurant is analysed. The conclusions are as follows.

First, three combined groups can be found when children were playing. Those are united, partly independent, and independent. When the number of children is less than 3 the main group is united. When the number is more than 7 the main group is independent. Three groups will all exist when the number is between 3 and 7. When there are 4 children in the playground, the sound pressure level of united group is maximum with 79.5dB, and the sound pressure level of independent is minimum with 74.5 dB.

Second, the changes in the number of children can affect the sound pressure level but it is not linearly

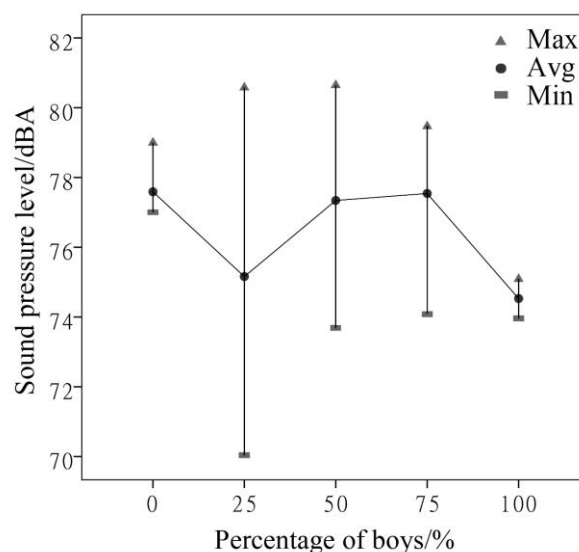


Figure 5. Relationship between number of boys and the sound pressure level, taking 4 children in the playground as an example.

enhanced. When the number of children is less than 4, the increase speed of the sound pressure level is the fastest with 3.9 dB per child; the sound pressure level is not changed much when the number is 4-7 with variation range of 76.8 dB-77.4 dB; the sound pressure level is increased slowly with 1.3 dB for every additional child when the number is more than 7.

Third, the gender composition of children has a certain influence on the sound pressure level. When the field is full of girls, the sound pressure level will increase generally by 2 dB over that when the field is full with boys and girls. On the other hand, when the field is full of boys, the sound pressure level will decrease generally by 2 dB over the level when there are boys and girls. The range of the sound pressure levels becomes larger when boys and girls are both present in the field. Especially when girls are more than boys, and the range of the sound pressure level is wider than that of other cases (70.0 dB-80.6 dB for girls more than boys and 73.9 dB-78.4 dB for other cases).

It is feasible to control the sound pressure level by setting up the maximum number of children in the playground, and it is also helpful with the management of the combination of children's gender in the playground. These results will be helpful to the setting up the children playground in the fast food restaurant.

This study may have several limitations due to the number of samples, so the number of samples will be increased in subsequent measurements. At the same time, the influence of the age of children and

the composition and characteristics of the sound source in the playground on the sound environment of fast food restaurants, and the subjective comfort of the customers in the fast food restaurants, will be studied in the future. In the attempt to act as a catalyst for further research on Chinese household expenditure patterns, particularly on FAFH, this study has shown that it is necessary to have an initial understanding of the factors that accelerate the change of expenditure patterns.

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