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**Tonal Development in  
Cantonese-English Bilingual Children**

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# Cantonese Tonal System

Cantonese use pitches to contrast difference in meanings.  
Below are the 6 tones in Cantonese.

Tone <sup>a</sup>	Syllable	Character	Gloss	Pitch <sup>b</sup>	Description <sup>c</sup>
1	/si/	詩	‘poem’	55	high level
2	/si/	史	‘history’	25	high rising
3	/si/	試	‘to try’	33	mid level
4	/si/	時	‘time’	21	low falling
5	/si/	市	‘city’	23	low rising
6	/si/	是	‘yes’	22	mid-low level

Note:

- a Some linguists treat the 3 entering tones (5, 3 and 2) as 3 separate tonal categories. In this study, we follow Matthews and Yip (1994) in treating these tones as the allotones of tone 1, 3 and 6 respectively.
- b We use Chao’s tone letters in describing the pitch level. 5 is the highest pitch level while 1 is the lowest pitch level.
- c Tones 1 to 3 are generally classified as high register tones while tones 4 to 6 are classified as low register tones in the literature. Tone 1, 3 and 6 are level tones while tone 2, 4 and 5 are contour tones.



# Previous Studies on the Acquisition of Cantonese Tone

Studies	Number of subjects	Age range	Type of studies <sup>a</sup>	Type of children <sup>b</sup>	Criteria for the acquisition of tone	Tone acquisition sequence <sup>c</sup>
So & Dodd (1995)	4	1;2 – 2;0	L	CAN	used contrastively on at least 50% of opportunities or correctly on 90% of opportunities	Earliest: 55, 33, 35
Tse A. (1992)	1	1;3 – 2;6	L	CAN	Tonal consistency	55, 33=35, 22, 21, 13
Tse J.K.P. (1978)	1	not specified	L	CAN	did not mention explicitly	55, 11, 33=25, 13=22
Fong (2004)	14	1;0 – 2;0	L & C	CAN	5% of occurrence of a particular tone in a 10-minute clip	55, 33, 35, 22, 13, 21
Law (2006)	1	1;08.28 - 3;00.03	L	CAN-ENG	few or no errors in a particular tonal category	Earliest: 55, 21 Latest: 13, 22

Note:

a L = longitudinal, C = cross-sectional      b CAN = Cantonese monolingual, CAN-ENG = Cantonese-English bilingual

c Tones on the left are early acquired ones while those on the right are the lately acquired ones.

The equal sign (=) means the two tones are acquired at the same stage.

General observations:

1. Tones in the high register are generally acquired earlier than tones in the low register.
2. Level tones are acquired earlier than contour tones.
3. Bilingual children need a longer period for a complete mastery of the Cantonese tonal system due to prosodic transfer from English.



# Research Questions

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1. To what extent is the developmental order of Cantonese tones in Cantonese-English bilingual children similar to or different from those in monolingual children?
2. Do bilingual children with different language dominance patterns have the same developmental patterns?
3. What are the characteristics of the tonal errors in bilingual children? Are there any influences from the English stress and intonation system on their Cantonese tone productions?



# Methodology

## ■ Subjects

Children	Sex	Age range of longitudinal data	Native language of father	Native language of mother	Children Type	Data Source
Llywelyn	M	2;00.12 – 3;04.14	English	Cantonese	Cantonese dominant bilingual	Yip & Matthews (2007)
Charlotte	F	1;08.28 – 3;00.03	English	Cantonese	English dominant bilingual	Yip & Matthews (2007)
K.C.	M	1;02.25 – 2;12.29	Cantonese	Cantonese	Cantonese monolingual	Tse (1992)

- The data of bilingual children are taken from the Hong Kong Bilingual Child Language Corpus (Yip and Matthews, 2007). The mean length of utterances (MLU) is used to assess the dominance pattern of the children.
- A re-analysis of the data of a monolingual child in A. Tse's (1992) study using our acquisition criteria was carried out so that the tonal development are comparable across monolingual and bilingual children.



# Methodology

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## ■ Data Analysis

The following items are excluded from our analysis of tonal development:

- (a) Utterances where the meaning is not clear
- (b) Kinship terms
- (c) Sentence final particles
- (d) Words with several possible adult tone pronunciations

- The author transcribed the tonal production of the bilingual children.
- Both the author and another transcriber re-transcribed approximately 10% of the utterances at a later time.
- The intra-rater reliability and inter-rater reliability are approximately 93% and 88% respectively.



# Methodology

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## Criteria in assessing tonal development

- We follow Zhu et al. (2001) in using two methods in assessing the tonal development of the bilingual children:
- Age of first emergence of tone:  
The time when a child can produce a target tone at least once in his spontaneous speech.
- Age of stabilization:  
The time when the accuracy rate reaches 66.7% and remains no less than 66.7% in all the subsequent speech samples.



# Results – Age of First Emergence of Tone

Children	Period of Investigation	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Bilingual - Llywelyn	2;00.12 to 3;04.14	2;00.12	2;00.12	2;01.13	2;00.12	2;00.12	2;01.13
Bilingual – Charlotte	1;08.28 to 3;00.03	1;08.28	1;08.28	1;08.28	1;08.28	1;08.28	1;08.28
Monolingual – K.C.	1;02.25 to 2;12.29	1;03.11	1;03.11	1;03.11	1;06.16	1;03.11	1;03.11

Most of the tones are emerged in the first recording session for both bilingual children. Therefore, this criterion cannot be used to differentiate the development of each tonal categories. The period of investigation may not be early enough to capture the early emergence of tone. Parental diary may be used in conjunction with the audio recordings in capturing the age of first emergence of each tonal categories.



# Results – Accuracy rates for each tonal categories

## Cantonese-dominant bilingual child – Llywelyn

Age	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
2;00.12	59% (7/12)	N/A (0/0)	N/A (0/0)	34% (1/3)	40% (2/5)	N/A (0/0)
2;01.13	67% (93/139)	60% (16/27)	78% (28/36)	58% (4/7)	54% (14/26)	40% (6/15)
2;02.03	57% (57/100)	62% (16/26)	83% (39/47)	34% (2/6)	60% (12/20)	67% (20/30)
2;02.29	39% (26/67)	80% (20/25)	38% (23/62)	59% (7/12)	40% (6/15)	43% (12/28)
2;03.14	<b>81% (57/71)</b>	55% (17/31)	<b>76% (37/49)</b>	20% (4/21)	52% (14/27)	25% (15/61)
2;04.12	<b>91% (102/113)</b>	56% (21/38)	<b>94% (74/79)</b>	34% (3/9)	54% (7/13)	67% (28/42)
2;05.10	<b>92% (116/127)</b>	89% (83/94)	<b>85% (73/86)</b>	91% (39/43)	40% (31/78)	53% (41/78)
2;06.20	<b>94% (168/179)</b>	73% (59/81)	<b>82% (91/111)</b>	49% (31/64)	58% (61/106)	66% (93/143)
2;07.04	<b>95% (222/235)</b>	85% (83/98)	<b>74% (116/157)</b>	54% (22/41)	51% (49/97)	71% (120/170)
2;07.18	<b>98% (114/117)</b>	69% (65/95)	<b>85% (79/94)</b>	49% (13/27)	41% (34/83)	65% (72/111)
2;08.08	<b>97% (152/158)</b>	75% (104/140)	<b>97% (81/84)</b>	55% (33/61)	65% (75/117)	84% (171/204)
2;09.07	<b>98% (182/187)</b>	58% (75/130)	<b>92% (92/100)</b>	41% (27/67)	50% (60/120)	60% (99/165)
2;10.04	<b>98% (171/176)</b>	59% (74/126)	<b>87% (76/88)</b>	49% (43/88)	<b>73% (83/114)</b>	82% (207/255)
2;11.29	<b>99% (71/72)</b>	<b>81% (54/67)</b>	<b>88% (47/54)</b>	28% (9/33)	<b>80% (79/99)</b>	62% (78/126)
3;00.27	<b>98% (183/187)</b>	<b>79% (74/94)</b>	<b>89% (61/69)</b>	58% (28/49)	<b>84% (103/124)</b>	85% (93/110)
3;01.04	<b>95% (110/117)</b>	<b>77% (81/106)</b>	<b>86% (57/67)</b>	39% (31/80)	<b>78% (84/109)</b>	72% (97/135)
3;04.14	<b>84% (40/48)</b>	<b>68% (54/80)</b>	<b>87% (33/38)</b>	38% (18/48)	<b>68% (43/64)</b>	59% (44/75)

Note: The numerator in bracket shows the number of correct productions of each tonal category and the denominator in bracket shows the total number of words which should be pronounced with that particular tone. The age period in which the tones are stabilized are shown in red.



# Results – Accuracy rates for each tonal categories

## English-dominant bilingual child – Charlotte

Age	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
1;08.28	<b>76% (25/33)</b>	63% (5/8)	75% (15/20)	100% (1/1)	84% (5/6)	84% (10/12)
1;09.12	<b>75% (12/16)</b>	62% (11/18)	64% (7/11)	45% (4/9)	13% (1/8)	39% (5/13)
1;10.09	<b>84% (26/31)</b>	40% (4/10)	73% (8/11)	100% (2/2)	45% (4/9)	27% (4/15)
2;00.25	<b>87% (33/38)</b>	40% (6/15)	44% (13/30)	20% (1/5)	50% (13/26)	20% (1/5)
2;01.22	<b>88% (28/32)</b>	43% (6/14)	55% (11/20)	25% (1/4)	54% (7/13)	40% (4/10)
2;02.06	<b>72% (10/14)</b>	0% (0/2)	60% (9/15)	40% (4/10)	60% (3/5)	80% (8/10)
2;03.17	<b>99% (75/76)</b>	0% (0/3)	83% (33/40)	0% (0/23)	100% (3/3)	47% (6/13)
2;04.20	<b>92% (105/115)</b>	21% (17/81)	72% (52/72)	6% (1/19)	46% (21/46)	17% (5/31)
2;05.19	<b>79% (25/32)</b>	60% (15/25)	66% (17/26)	31% (4/13)	77% (49/64)	25% (6/24)
2;06.16	<b>98% (38/39)</b>	64% (12/19)	<b>82% (35/43)</b>	34% (2/6)	53% (10/19)	27% (15/56)
2;08.06	<b>79% (18/23)</b>	50% (1/2)	<b>67% (10/15)</b>	25% (1/4)	17% (1/6)	27% (11/41)
2;09.19	<b>74% (11/15)</b>	60% (3/5)	<b>67% (6/9)</b>	N/A (0/0)	50% (1/2)	37% (4/11)
2;10.15	<b>80% (61/77)</b>	52% (22/43)	<b>78% (31/40)</b>	20% (1/5)	16% (2/13)	17% (17/103)
2;10.29	<b>99% (60/61)</b>	29% (2/7)	<b>92% (63/69)</b>	N/A (0/0)	34% (3/9)	45% (48/109)
3;00.03	<b>90% (9/10)</b>	50% (2/4)	<b>80% (4/5)</b>	<b>75% (3/4)</b>	40% (2/5)	24% (3/13)

Note: The data from recording sessions 1;11.05, 2;02.18, 2;07.23 and 2;09.04 are excluded from analysis since only a few Cantonese utterances are recorded in these sessions.



# Results – Accuracy rates for each tonal categories

## Cantonese monolingual child – K.C.

Age	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
1;02.25 - 1;03.11	49% (34/70)	14% (1/7)	33% (1/3)	0% (0/5)	N/A (0/0)	0% (0/1)
1;05.24 - 1;06.16	75% (41/55)	25% (1/4)	45% (5/11)	5% (1/20)	7% (1/15)	100% (2/2)
1;08.21 - 1;08.30	57% (64/113)	100% (3/3)	45% (13/27)	13% (1/8)	8% (1/12)	60% (15/25)
1;11.11 - 1;11.22	<b>76% (65/85)</b>	57% (8/14)	<b>85% (23/27)</b>	25% (1/4)	11% (2/18)	<b>88% (7/8)</b>
2;02.03 - 2;02.21	<b>92% (109/118)</b>	<b>92% (61/66)</b>	<b>81% (29/36)</b>	23% (6/26)	40% (6/15)	<b>75% (30/40)</b>
2;04.19 - 2;05.10	<b>96% (137/143)</b>	<b>88% (64/73)</b>	<b>73% (58/79)</b>	56% (25/45)	65% (41/63)	<b>91% (83/91)</b>
2;06.30 - 2;07.14	<b>90% (118/131)</b>	<b>90% (86/96)</b>	<b>88% (69/78)</b>	23% (9/40)	39% (18/46)	<b>89% (73/82)</b>
2;09.15 - 2;10.01	<b>95% (169/178)</b>	<b>69% (78/113)</b>	<b>84% (111/132)</b>	64% (37/58)	33% (20/60)	<b>80% (71/89)</b>
2;12.08 - 2;12.29	<b>92% (182/197)</b>	<b>89% (114/128)</b>	<b>89% (127/142)</b>	61% (57/94)	44% (26/59)	<b>88% (91/104)</b>



## Results – Tonal Substitution Patterns

### Cantonese-dominant bilingual child – Llywelyn

Child's Production	Target Production					
	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Non target	0% (1)	0% (0)	0% (1)	0% (0)	1% (5)	1% (3)
Tone 1 [55]	--- ---	20% (72)	<b>45% (97)</b>	6% (19)	31% (143)	12% (65)
Tone 2 [25]	17% (40)	--- ---	35% (75)	7% (24)	<b>43% (198)</b>	15% (82)
Tone 3 [33]	<b>60% (140)</b>	<b>47% (172)</b>	--- ---	<b>51% (177)</b>	15% (70)	<b>53% (295)</b>
Tone 4 [21]	16% (38)	4% (16)	3% (7)	--- ---	3% (15)	5% (30)
Tone 5 [23]	3% (8)	16% (58)	5% (10)	20% (68)	--- ---	14% (77)
Tone 6 [22]	3% (7)	12% (45)	11% (24)	16% (56)	6% (29)	--- ---
Total	100% (234)	100% (363)	100% (214)	100% (344)	100% (460)	100% (552)

Note: The number in brackets shows the number of tokens for that particular tonal category. The most frequent substitution patterns for each tonal category are shown in red.

The mid-level tones (tone 3) was used frequently by the Cantonese-dominant bilingual child Llywelyn to substitute other target tones.



## Results – Tonal Substitution Patterns

### English-dominant bilingual child – Charlotte

Child's Production	Target Production					
	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Non target	11% (9)	1% (1)	3% (3)	0% (0)	1% (1)	1% (2)
Tone 1 [55]	--- ---	<b>40% (61)</b>	<b>52% (62)</b>	26% (22)	31% (36)	<b>44% (147)</b>
Tone 2 [25]	20% (16)	--- ---	15% (18)	13% (11)	13% (15)	5% (18)
Tone 3 [33]	<b>49% (39)</b>	<b>43% (65)</b>	--- ---	<b>56% (48)</b>	<b>46% (54)</b>	<b>45% (149)</b>
Tone 4 [21]	6% (5)	5% (7)	14% (17)	--- ---	1% (1)	1% (5)
Tone 5 [23]	3% (2)	9% (14)	8% (10)	3% (3)	--- ---	4% (13)
Tone 6 [22]	11% (9)	3% (4)	8% (9)	2% (2)	9% (11)	--- ---
Total	100% (80)	100% (152)	100% (119)	100% (86)	100% (118)	100% (334)

The level tones in the high register (tones 1 and 3) were used frequently by the English-dominant bilingual child Charlotte to substitute other target tones.



## Results – Tonal Substitution Patterns

### Cantonese monolingual child – K.C.

Child's Production	Target Production					
	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Non target	0% (0)	0% (0)	0% (0)	1% (1)	0% (0)	0% (0)
Tone 1 [55]	--- ---	<b>45% (40)</b>	<b>68% (69)</b>	12% (19)	18% (32)	26% (18)
Tone 2 [25]	9% (16)	--- ---	8% (8)	6% (9)	<b>49% (84)</b>	10% (7)
Tone 3 [33]	<b>65% (112)</b>	35% (31)	--- ---	13% (22)	21% (36)	<b>53% (37)</b>
Tone 4 [21]	1% (1)	0% (0)	3% (3)	--- ---	3% (6)	9% (6)
Tone 5 [23]	5% (8)	15% (13)	2% (2)	2% (4)	--- ---	3% (2)
Tone 6 [22]	20% (34)	5% (4)	19% (19)	<b>66% (108)</b>	9% (15)	--- ---
Total	100% (171)	100% (88)	100% (101)	100% (163)	100% (173)	100% (70)

Unlike the bilingual children, the Cantonese monolingual child K.C. mainly used the low-level tone (tone 6) to substitute the low-falling tone (tone 4) and used the high-rising tone (tone 2) to substitute the low-rising tone (tone 5).



# Summary of Results

## Age of Emergence of Tone

Children	Period of Investigation	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Bilingual - Llywelyn	2;00.12 to 3;04.14	2;00.12 ①	2;00.12 ①	2;01.13 ⑤	2;00.12 ①	2;00.12 ①	2;01.13 ⑤
Bilingual – Charlotte	1;08.28 to 3;00.03	1;08.28 ①	1;08.28 ①	1;08.28 ①	1;08.28 ①	1;08.28 ①	1;08.28 ①
Monolingual – K.C.	1;02.25 to 2;12.29	1;03.11 ①	1;03.11 ①	1;03.11 ①	1;06.16 ⑥	1;03.11 ①	1;03.11 ①

## Age of Stabilizations (66.7% Accuracy Criterion)

Children	Period of Investigation	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Bilingual - Llywelyn	2;00.12 to 3;04.14	2;03.14 ①	2;11.29 ④	2;03.14 ①	not yet	2;10.04 ③	not yet
Bilingual – Charlotte	1;08.28 to 3;00.03	1;08.28 ①	not yet	2;06.16 ②	not yet	not yet	not yet
Monolingual – K.C.	1;2.25 – 2;12.29	1;11.22 ①	2;02.21 ④	1;11.22 ①	not yet	not yet	1;11.22 ①

## Major Tonal Substitution Patterns

Children	Period of Investigation	Tone 1 [55]	Tone 2 [25]	Tone 3 [33]	Tone 4 [21]	Tone 5 [23]	Tone 6 [22]
Bilingual – Llywelyn	2;00.12 to 3;04.14	Tone 3	Tone 3	Tone 1	Tone 3	Tone 2	Tone 3
Bilingual – Charlotte	1;08.28 to 3;00.03	Tone 3	Tone 1,3	Tone 1	Tone 3	Tone 3	Tone 1,3
Monolingual - K.C.	1;2.25 – 2;12.29	Tone 3	Tone 1	Tone 1	Tone 6	Tone 2	Tone 3



# Patterns of Tonal Errors

- (i) [ma<sup>25</sup>ma<sup>25</sup> ts<sup>h</sup>a<sup>21</sup> hɛu<sup>25</sup>sen<sup>55</sup>kou<sup>55</sup> a<sup>21</sup>] /sen<sup>21</sup>kou<sup>55</sup>/  
 mother put lipstick SFP  
 ‘Mother is putting on lipstick.’ (Llywelyn 2;06.20)
- (ii) [pat<sup>5</sup>tim<sup>55</sup>tsun<sup>55</sup> sik<sup>2</sup> je<sup>23</sup>] /pat<sup>3</sup>tim<sup>25</sup>tsun<sup>55</sup>/  
 eight o’clock eat thing  
 ‘eat at eight o’clock.’ (Llywelyn 3;00.27)
- (iii) [ŋɔ<sup>22</sup> m<sup>22</sup> tsi<sup>22</sup>tou<sup>22</sup> hei<sup>22</sup> mɛ<sup>22</sup> lai<sup>21</sup>] /ŋɔ<sup>23</sup>m<sup>21</sup> tsi<sup>55</sup>tou<sup>33</sup> hei<sup>22</sup> mɛ<sup>55</sup>/  
 I NEG know is what SFP  
 ‘I don’t know what it is.’ (Llywelyn 3;00.27)
- (iv) [t<sup>h</sup>un<sup>55</sup>mai<sup>55</sup> ko<sup>55</sup> ten<sup>55</sup>] /t<sup>h</sup>un<sup>21</sup>mai<sup>21</sup> ko<sup>33</sup> ten<sup>55</sup>/  
 and classifier light  
 ‘and the light’ (Llywelyn 3;04.14)

Similar to consonant and vowel harmony, tonal harmony may also be found during the developmental stages. In the above examples, the errors may be caused by the tonal assimilation of the neighboring syllables within the same phrases or lexical items.

Note: The IPAs in brackets were the actual utterances produced by the child. The underlined IPAs (in red) are the syllables in which the tones may be affected by the neighboring syllables. The adult pronunciations of these words are shown (in blue) between the slashes.





# Conclusion

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- A universal acquisition order of tone is observed in both monolingual and bilingual children:
  - High level tones are acquired than lower level tones
  - Level tones are acquired earlier than contour tones
- A longer period is needed by bilingual children to master the Cantonese tonal systems. This may be due to the fact that bilingual children receive less Cantonese input when compared with monolingual children. The same is also true for bilingual children with different language dominance patterns. English-dominant child Charlotte shows a more delayed development when compared with the Cantonese-dominant child Llywelyn.
- The mid-level tone (tone 3) seems to be an unmarked tone which was used frequently by the bilingual children to substitute other target tones. This may be due to the influence from the English intonation system.



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