CHAPTER SEVEN: THE DISCUSSION

7.1. The Introduction

As Mull (1925) and Ward (1999) have suggested, most of the mystery surrounding AP can be revealed if a method is discovered to train average individuals to develop AP successfully. From the findings of this research, LCK MusET appears to be the one.

7.2. Definition of AP

AP, according to the researcher, is an innate ability to identify or produce tones with octave designations accurately, with certainty, spontaneously and effortlessly without reference and at least for one timbre.

This definition is different from conventional ones by pointing out that AP is an innate potential. It is an ability that everyone can acquire through learning. The identification should include octave designations. Wrong octaves should be counted as part of the mistakes. AP possessors should identify tones at least from one timbre or from one musical instrument. Like conventional definitions, the AP judgment should be accurate, certain, spontaneous and effortless like identifying well-known colours, characters or images. It should be absolute without any reference. The possessor can use recognition or production to demonstrate the trait (Bachem, 1937, 1940, 1954, 1955; Miyazaki, 1989, 1990, 1995; Parncutt & Levitin, 1999; Ward 1999).

7.3. Terminology of AP

The “memory for AP” (Abraham, 1901, cited in Petran, 1932), “absolute determination of pitch” (Meyer, 1911, cited in Petran, 1932), “judgment of absolute tone” (Ladd & Woodworth, 1911), “positive pitch” (Copp, 1916), “absolute ear” (Watt, 1917) and “perfect pitch” (e.g. Lundin & Allen, 1962; Lundin, 1963; Lockhead & Byrd, 1981; Profita & Bidder, 1988; Rutz, 1996; Gregersen & Kuma, 1996; Eppstein, 1997; Evangelista, 1998; Dickinson, 1999; Graham, 1999; J.T., 2000; Macpherson, 2000; Abrams, 2001, Hamer, 2001; Johanse-Berg, 2001; Willet, 2001; Hall, 2002; Stary, 2002) are not appropriate terms to describe the absolute identification of tones. Of these terms, “perfect pitch” has been

widely used. It should not be another term for AP (Petran, 1932; Hall, 1982; Levitin, 1998). The absolute tonal judgment can be perfect but quite rare. Under LCK MusET, there was only one girl who could achieve 100% right in tone and octave judgments. Even though the AP10 girl may have been perfect in piano tones, she may not have been perfect in other instrumental tones or pure tones. AP involves an absolute judgment of isolated pitches. So, "AP" should be the term.

7.4. Measurement of AP

The AP assessment, scoring and grading system used in this study can be developed into a standardized measure for AP. The test is conducted in a quiet room. A sound-proof room is unnecessary. Test tones can be generated from the piano, the synthesizer, tuning forks or the major instrument of the examinee since one should primarily identify tones from the major instrument one is playing. Instruments must be tuned to A440 Hz. All the tones of the chosen instruments should be used, for examples, 88 tones (A_4-C^4) from the piano, 46 tones (G_1-E^2) from the violin, 37 tones (C_o-C^3) from the flute, 32 tones ($F\#_1$-C^2) from the trumpet, 27 tones (Bb_1-C^2) from the glockenspiel and 22 tones (C_o-A^1) from the soprano voice. Each test tone lasts for one second. The distance between test tones is at least a major tenth apart and tones are randomly ordered to avoid RP. Test tones may be presented live, or recorded with high fidelity audio equipment and presented free field through loudspeakers or headphones. If test tones are presented live, examinees sit at desks with the back against the instruments. Examinees respond one tone after another within three seconds. Complete answers must include note names and octave placements. They can name or notate answers on the manuscript paper. The inter-stimulus interval is at least 30 seconds. The dialogue between examiners and examinees serves as the inter-stimulus distraction. Examiners use stop-watches or timers to count the time if needed. Each answer with the right note and wrong octave name gets one mark and that with both right note and octave designations gets two marks. The total score is calculated into a percentage.

Strictly speaking, if one identifies one tone without reference accurately and immediately,

one is an AP possessor, but an AP for one tone. If one identifies many tones without reference, one can be called an AP for many tones. Similarly, if one identifies tones limited to one timbre, one can be considered an AP for one timbre. If one identifies tones of all timbres, one can be called AP for all timbres. For example, if one can get a score from 50% to 59% in piano tones, one can be called "Piano AP5". A "Flute AP8" gets 80% to 89% accurate answers for flute tones. This naming system has the advantage of being able to precisely label how many tones one can name and for what instrument. Refer to Section 3.5, p.116 for the AP scoring and grading scheme.

7.5. LCK MusET Helps to Develop AP

None of the 144 subjects could identify a tone in the pretest. In the post-test, 122 subjects (84.7%) achieved AP1-10. Out of them, 64 attained AP5-10. All except one reported using AP solely in the post-test. One 23-year-old student, learning the piano for three months, reported using both AP and RP. All subjects' responses were made within three seconds after one-second test tones. All examiners reported that subjects gave accurate answers immediately and certainly, and used AP. Therefore, all AP1-10 subjects were AP possessors, including the 23-year-old student.

Subjects might develop AP through music activities outside MusH. From 144 subjects, only one AP 10 and one AP7 reported that playing the violin, flute and in the orchestra helped them to develop AP because they had to tune instruments. Tuning instruments may help one to develop an internal reference tone, but not AP as an overall ability (Bachem, 1937, 1955; Costall, 1985). From the researcher's observation, it seems that the AP developed at MusH helped them to tune and play instruments instead of vice versa. In the pretest, only four (2.6%) out 154 piano students possessed small degrees of AP. The prevalence rate and the accuracy were low. Furthermore, no subject reported that there was any institution or activity teaching them AP or employing AP as a medium of instruction or tone acquisition. In kindergartens, primary and secondary schools of Hong Kong, RP is widely exercised. AP would only be suppressed under the RP environment (Crozier, 1997).

In naming five factors to develop AP, no subject indicated that their AP was being learnt somewhere outside MusH. The data support that the idea that the music environment in Hong Kong does not favour AP growth. Subjects can hardly develop AP outside MusH.

Concerning the effect of music activities at MusH in developing AP, five (0.7%) responses from 757 responses of 144 subjects indicated "No". Three (0.4%) rep lied "Not Sure". Others (98.9%) reported "Yes". In fact, those saying no or unsure in one activity said yes in other activities. All subjects agreed to that the music activities at MusH helped them to develop AP. In naming five factors to develop AP, 122 AP1-10 stated, in order of importance, singing solfège in practising the piano (N=119, 97.5%), practising the piano without singing solfège (N=94, 77.1%), listening to music (N=51, 41.8%), playing the piano from memory (N=49, 40.2%), sight-singing (N=43, 35.3%), singing (N=34, 27.9%), sight-playing (N=29, 23.8%), practising the tone identification (N=14, 11.5%), learning music theory (N=6, 4.9%), composing (N=3, 2.5%) and conducting (N=2, 1.6%) as influencing factors. The activities of LCK MusET are reported to be the media that enable subjects to develop AP.

There were 22 (15.3%) AP0s, including seven SEN (49%) and 15 (10.4%) MS children. Except for four (2.8%) students, all (N=18, 12.5%) got 1.14% to 9.09% marks in the post-test. They made one to six right judgements. They were advised not to guess in the test. They were not good at guessing due to their young ages and /or disabilities. Their answers might not be by chance. Comparing to the zero score in the pretest, these results indicate that their AP was improving. They were in fact starting to acquire AP. Out of them, 17 (11.8%) subjects reported employing AP in the post-test, while 12 (8.3%) were observed by examiners to use AP. Even though they failed to attain AP1, they (N=18) had started to develop AP. They were new and/or did not follow LCK MusET to learn music. They needed a longer time to attain AP1 or higher.

7.5.1. Factors Affecting AP Development under LCK MusET

Besides the music activities of LCK MusET, there may have been other criteria under LCK

MusET influencing the development of AP, i.e. the tonal-labelling association, accurate piano tuning to A440, familiarity of musical tones, interest for playing the piano and attention.

7.5.1.1. Tone and Absolute Solfège with Octave Designations Association

AP development depends on how successfully one anchors labels to tones (Miyazaki, 1988; Levitin, 1998). A fixed solfège system is crucial (Ward, 1999). Under the note naming system of LCK MusET, each note is associated to an independent sol-fah name and octave designation (see Section 3.2, pp.108 and Appendix I.4, I.5 & I.6, pp.301-304). Absolute tones can be reinforced with the AP naming. It is even more effective when students still centre on parts rather than on the relativity of music (Takeuchi and Hulse, 1993).

Another criterion is the exposure to tones. The more one exposes oneself to music, the better one can develop AP (Miyazaki, 1989, 1990; Simpson & Huron, 1994). The absolute solfège singing was employed in all music activities. Out of 144 subjects, 136 (94.4%) sang or thought of tones in practising the piano. They got significantly higher post-test scores than those who did not ($F=11.12$, $df=1, 141$, $p=.001$, 2-tailed). Logically, subjects who spent more time practising the piano got significantly higher mean post-test score than those who spent less ($rho=.571$, $df=138$, $p=.000$, 2-tailed). Eight (5.6%) AP0-2 did not sing or think of tones in the piano playing. Some (one AP1 and three AP2) might start to develop AP because they would hear the demonstration in class and the recording of the demonstration with solfège singing from their instructors. They would sing and think of tones in other music occasions. They could still learn the tone naming and develop AP even though their AP achievement was significantly lower.

Students sang or thought of tones in 85.64% of the activities attended (63.99%), including playing the piano, playing the piano from memory, sight-playing, singing, sight-singing, music listening, composition, conducting and learning music theory. They used AP in 99.11% of the occasions. It was found that the more they sang and thought of absolute solfège in music activities, the higher would be their AP achievement ($rho=.744$, $df=142$,

p=.000, 2-tailed).

LCK MusET makes AP dominant over RP. Even though under the use of RP in schools and music functions in the society widely, students keep using AP as the main tonal recognition and communicative strategy. The method is successful to make students develop AP ultimately. Therefore, the approach of associating tones to absolute solfège and developing the association through singing and thinking of tones in their absolute sense is one of the factors in developing AP.

7.5.1.2. Accurate Tuning

Musicians getting used to different tunings may identify tones tuned to A440 one semitone higher or lower (Petran, 1932; Bachem, 1937; Ward, 1963). In this study, from 140 subjects who practised the piano in the piano learning, five (3.6%) subjects reported their pianos being out of tune. Two were AP0, one was AP1, one was AP2 and one was AP6. After examining their pianos, the piano tuner found that the tones of the pianos of the AP0-2 were out of tune due to the lack of tuning for a long time. Some tones of the AP6's piano were only slightly lower. Her AP was so keen that she could discriminate minute tonal differences. Anyway, subjects claming to have the inaccurate piano tuning got a significantly lower mean score in the post-test than those claiming to have in-tuned pianos (F=4.08, df=2, 141, p=.019). Accurate piano tuning therefore seems to be a significant factor in developing AP.

In naming five factors to develop AP, 79.3% (N=111) of the subjects were of the view that in-tuned pianos were helpful. That the accurate tuning is crucial in developing AP was supported further by their feedback.

7.5.1.3. Familiarity of Musical Tones

AP is not an all-or-nothing ability. It depends on familiarity (Simpson & Huron, 1994; Gregersen et al, 1997; Baharloo et al, 1998, 2000; J.T, 2000; Stary, 2002). The first related criterion is the duration of playing the piano. In this study, it was found that there were significant differences among the mean AP scores of subjects playing the piano for

different durations (F=10.51, df=13, 130, p=.000). The mean score of the subjects learning the piano less than a year was the lowest and it was significantly lower than those learning one to eight years (p=.000). Moreover, the AP achievement was found to be positively and highly correlated to the years of playing the piano (rho=.068, df=142, p=.000, 2-tailed). The subjects playing the piano for one to two months got the lowest mean score of 16.21%, whereas the subjects playing the piano for seven to eight years got the highest mean score of 87.27%. The longer the time students play the piano, the better are their AP achievement. As mentioned above, the subjects who spent more time practising the piano got significantly higher scores than those who spent less. The more they used AP to sing and think of tones in music activities, the higher would be their AP achievement (rho=.74, df=142, p=.000, 2-tailed). The findings proved that AP depends on familiarity of tones.

Another influence is the familiarity of timbre (Takeuchi & Hulse, 1993; Hantz et al, 1997; Marvin & Brinkman, 2000). However, Bachem (1937) and Sergeant (1969) found no timbre influence. Miyazaki (1989) found the timbral familiarity an auxiliary rather than a determining factor. In the present study, only four (2.8%) subjects practised the electronic piano in learning the piano. The subjects practising the piano (N=140, 97.2%) got a significantly higher mean post-test score than those practising the electronic piano (t=2.04, df=142, p=.043, 2-tailed). Undoubtedly, the longer the time they used the piano to practise, the higher would be their AP scores (rho=.57, df=138, p=.000, 2-tailed). Moreover, one AP5 trumpet player commented that the trumpet tones hindered him from identifying piano tones. These findings are consistent with the notion that the timbre familiarity exists in the AP judgment. Since there were two AP2s practising the electronic piano, the timbral familiarity appears to be an auxiliary rather than a determining factor. This finding is consistent with Miyazaki's (1989) proposition.

Even though piano tones are believed to be the easiest tones to recognize among all instrumental tones (Miyazaki, 1989; Marvin & Brinkman, 2000), AP is not more prevalent among piano students. Under LCK MusET, nearly all students possess AP except new

students and those fail to follow LCK MusET to learn music. A high exposure to piano music is another factor. There are 12 books or 12 sets of books in each grade (refer to Appendix I.1, pp.288-293 for the piano syllabus). As they proceed, students encounter more different tones. Through playing and singing tones, they get more familiar with tones and their associations to absolute solfège. Under sufficient tone-label perceptual input, AP grows. The tonal familiarity is thus another crucial factor in developing AP.

7.5.1.4. Interest for Piano Playing

Some AP musicians and musical savants liked music or liked to play instruments (Anastasi & Levee, 1960; Collier, 1983; Sloboda et al, 1985; Slonimsky, 1988; Charness, Clifton, & MacDonald, 1988; Mottron et al, 1999). The interest in music may be associated with AP development.

In this study, 12 (8.3%) subjects had no or little interest in playing the piano. Others (N=132, 91.7%) had moderate to very great interest. The differences of mean AP scores were significant among groups of different levels of interest ($F=4.03$, $df=4, 139$, $p=.004$). Those with little interest (N=10, 6.9%) had significantly lower scores than other groups. And subjects' interest in playing the piano was positively correlated to their AP achievement ($rho=.25$, $df=142$, $p=.003$). The more interest students have in playing the piano, the higher will be their AP achievement.

Promoting students' interest for music and the piano performance is one of the tasks in LCK MusET. The basic strategy is to promote students' sense of achievement in playing the piano. They are more likely to develop interest if they can play the piano well. They should have enough studies, exercises and repertoire to build up piano technique gradually. Pieces with beautiful melodies are selected, so as to make them enjoy music when they practise the piano. Public concerts are organized each year for students to enhance their sense of achievement. Children are accompanied with parents or maids in learning the piano. They can help their children to solve elementary problems at home and read music stories to them. CDs of favourite classical music and songs for children were played for

enjoyment or as background music at home. They are free to join activities such as ensemble playing, sight-playing, singing, sight-singing, composing, conducting, music listening, tone identification and music theory. Piano instructors are always trained to give encouragement to students. Refer to Section 1.4, pp.36-37 for the method.

7.5.1.5. Influence of Attention on Accuracy

AP achievement is influenced by attention (Boggs, 1907; Bachem, 1940), illness, fatigue (Sergeant, 1969), anxiety and stress (Wynn, 1971, 1972). In taking the AP test, children may not possess sufficient attention. They treated the test as games. They would play, run, chat, jump, swing, stand here and there, laugh or cry during the test. Twenty-four (16.7%) and one (0.7%) subjects were reported to have severe attention and stress problems respectively. Three were MS and 22 were SEN. They got a significantly lower mean post-test score than those without such behaviour (t=-2.10, df=142, p=.038, 2-tailed). Attention influences AP achievement.

7.5.2. Factors Not Affecting AP Development

There have been arguments that the gender, aptitude, language background, age of onset, acute memory for AP, auditory hypersensitivity, pitch identification training, inheritance, tinnitus and chromesthesia may influence the AP development.

7.5.2.1. Sex Difference

The present study supports no gender difference. There were 34 (53.1%) boys and 30 (46.9%) girls attaining to AP5-10. The number of boys who successfully acquired AP was not significantly more than that for girls (X^2=.25, df=1, p>.05). The mean post-test score of girls was not significantly higher than that of boys (t=.55, df=62, p>.05, 2-tailed). The findings are consistent with those of Petran (1932), Sergeant (1969) and Baharloo et al (1998). It seems that either sex can develop AP equally well under LCK MusET.

7.5.2.2. Aptitude Difference

In the present study, 28.6% to 100% of those attaining to AP5-10 were either AT, MS, autistic, EBD, LD, SID, moderate HI, severe HI or asthma subjects. In the SEN, only one

mild MR and three SD subjects failed to develop to AP5 because they were new. They came to MusH for one to six months and were still in the preparatory grade. For the AP1-10, 66.7% to 100% were either AT, MS, autistic, EBD, SD, LD, SID, moderate HI, severe HI or asthma subjects. In the SEN, only the one mild MR subject failed to do so since he was a new student in the preparatory grade. Different SEN students possess different types and levels of attention, learning, behavioural and perceptual difficulties. They could develop AP and did not get a significantly lower mean post-test score than the MS ($F=2.34$, $df=2, 141$, $p>.05$, 2-tailed). All the three AT, 41.7% (N=43) of MS and 47.4% (N=18) of SEN were able to attain to AP5-10. The percentages of MS and SEN were similar. The differences of the mean post-test scores of these three groups were non-significant ($F=.97$, $df=2, 61$, $p>.05$). Therefore, AP is independent from aptitude. The findings are consistent with those proposed by Heaton et al (1998).

7.5.2.3. Age of Onset

Musicians with AP usually start music training before six years of age (Takeuchi & Hulse, 1993; Sacks, 1995; Gregersen et al, 1999). The 144 subjects in this study started to learn to play the piano from the age of two to 23. Their differences in the mean post-test scores were found non-significant ($F=.68$, $df==10, 133$, $p>.05$). Of 122 Ap1-10 subjects, their age of commencing piano playing was negatively correlated to their AP achievement ($r=-.18$, $df=120$, $p=.000$). Of 64 AP5-10, The AP achievement was negatively associated with the age of onset with a low and non-significant correlation too ($rho=-.102$, $df=62$, $p>.05$). The AP5-10 subjects were regrouped to two groups, i.e. one at two to six years of age and another seven to 23. It was found that students commencing piano playing at the age of two to six did not attain a significantly higher mean score than those commencing at seven to 23 ($t=1.35$, $df=62$, $p>.05$, 2-tailed). The findings did not support the early music training in the AP development. The age of onset is not a determining factor. The findings support the Learning Theory that AP can be acquired at any age through proper training (Brady, 1970; Corliss, 1973; Eaton & Eaton, 1976). Persons of any age can possess AP under LCK

MusET, at least before the onset age of 23.

7.5.2.4. Language Background

There has been a proposition that the speakers of tonal language can retain AP and develop AP better than those speaking phonetic languages (Deutsch, 1999). In this study, four (2.8%) subjects spoke English while others (N=140, 97.2%) spoke Cantonese which is a tonal language. Results showed that the English speaking subjects achieved a higher mean post-test score than that of the Cantonese speaking subjects though the difference was non-significant ($t=-.49$, $df=142$, $p>.05$, 2-tailed). The language background is not an influencing factor in the AP development. Persons with or without the tonal language background can acquire AP under LCK MusET.

7.5.2.5. Acute Memory for AP

There has been a supposition that AP is developed from an acute memory for pitch (van Krevelen, 1951; Pollack, 1952; Oakes, 1955). In this study, 122 (84.7%) students achieved AP1-10. Eighteen (12.5%) got scores of 1.14% to 9.09%. Only four (2.8%) new subjects did not get any marks. The proposition that AP is developed from the acute memory for pitch can be ruled out. Ordinary individuals with different levels of memory ability can develop AP under LCK MusET.

AP is a successful transfer of tones from the short-term to long-term memory (Klein et al, 1982; Hantz, 1992; Tervaniemi et al, 1993; Crummer, et al, 1994). It can be done by every student under LCK MusET. The widespread use of AP in all music activities, the habitual singing and thinking of tones in practising the piano, and the frequent listening to recordings of piano music with solfège singing and to CDs of classical music are the media. It is suggested that through the frequent active rehearsal and exposure to tones, ordinary individuals can store AP in the long-term memory successfully, as the frequent rehearsal process suggested by Atkinson & Shiffrin (1977) and the active rehearsal process proposed by Bekerian and Baddeley (1980) in transferring information from the short-term to the long-term memory.

7.5.2.6. Auditory Hypersensitivity

There has been a belief that AP can be developed if people have a super auditory sensitivity to sound. Boggs (1907) and Watt (1917) believed that AP possessors have an exceptionally refined hearing for tones. Bachem (1940) found musicians having AP declining with deafness. Profita and Bidder (1988) suggested a hypothesis of the auditory hypersensitivity to explain AP development. Anastasi et al (1960) and Mottron et al (1999) used this theory to explain the trait in autistic persons. Wayman et al (1992) found that AP persons have an extraordinary auditory sensitivity at the cortex. However, Sergeant (1969) did not find his AP subjects had greater hearing acuity than the non-AP in the audiometric measurement. On the contrary, the average hearing loss of AP subjects was even higher than that of the non-AP. Fujisaki and Kashino (2002) did not find AP persons possess particularly sensitive or "good ears" (p.83) for frequency, temporal and spatial resolutions either.

In this study, the prevalence rates of the auditory hypersensitive (autistic) subjects were 0.2% and 15.8% lower than that of the normal hearing (AT and MS) subjects in AP1-10 and AP5-10 groups respectively. Despite the hearing loss from 25dBHL to 75dBHL, one HI was AP1-4 and three were AP5-10. The prevalence rate was 30.6% and 46.4% in AP5-10, and 14.1% and 14.3% in AP1-10 higher than those of the normal hearing and auditory hypersensitive subjects respectively. The mean score of the HI was the highest (M=50.85, SD=28.57). The second highest was that of the normal hearing (M=43.86, SD=27.93). The lowest belonged to that of the auditory hypersensitive group (M=32.55, SD=20.72). But those differences were non-significant ($F=1.25$, $df=2, 121$, $p>.05$). Auditory hypersensitivity is not a factor in developing AP.

The present findings showed that auditory hypersensitive, HI and normal hearing persons can develop AP equally well. Under LCK MusET, all students are directed to develop auditory awareness to music through singing solfège and listening to music frequently in

the everyday piano practice and music listening. The inborn auditory hypersensitivity is not a factor of developing AP. All students with different levels of auditory sensitivity can develop AP under LCK MusET.

7.5.2.7. Pitch Identification Practice

There is a belief that AP development and pitch accuracy depend on how much one practises the pitch identification (Brady, 1970; Corliss, 1973; Eaton & Siegel, 1976; Simpson & Huron, 1994; Crozier, 1997). Miyazaki (1992) suggested that ear training is sufficient to develop AP. However, Levitin (1998) and Levitin and Zatorre (2003) argued that the ear training emphasizes RP instead of AP. AP can only be developed from the systematic training in pitch and labeling tasks.

In the present study, out of 144 subjects, 16 (11.1%) practised pitch identification and 128 (88.9%) did not. Subjects practising the pitch identification did not get a significantly higher mean post-test score than those without ($t=.96$, $df=142$, $p>.05$, 2-tailed). Even though more AP5-10 subjects (N=10, 6.9%) practised pitch identification than the AP0-4 (N=6, 4.2%), AP5-10 subjects practising the pitch identification did not get a significantly higher mean AP score than those without either ($t=.73$, $df=62$, $p=>.05$, 2-tailed). Surprisingly, it was found that the pitch identification practice exerts no determining influence on AP development. Students may make improvement in the AP achievement through the pitch identification training. Students without practising the pitch identification can develop AP too. It is through singing and thinking of absolute solfège in general music activities instead of the deliberate training in tonal and labeling tasks, students develop AP (Baddeley, 1976).

7.5.2.8. Inheritance

The etiology of AP has been an argument among researchers for more than a century after Stumpf brought the issue into research in 1883 (Wedell, 1934; Ward, 1999). The main query lies on whether AP is genetically inherent to a few or a universal potential to ordinary individuals. In order to rule out the genetic influence, Ward (1999) suggested that

a method has to be designed to train at least all children to develop AP.

In this study, nearly all subjects possessed AP or started to possess AP, except new students and those not following LCK MusET to learn music. Nobody reported that their family members were professional musicians or had a music level up to a professional standard. None of their parents or grandparents was reported to possess AP. All their 17 brothers and sisters with AP were students or ex-students of MusH. Further, in naming five factors to develop AP, no subject claimed that their AP was from inheritance. The possibility that AP has a genetic factor may be ruled out. AP should be an innate potential to all. The finding is consistent with Takeuchi's and Hulse's (1993) postulation that "everyone initially has the potential to acquire AP" (p.357), Levitin's (19 94) proposition that "everybody does have AP to some extent" (p.414) and AP is "widespread in general population" (p.415), and Saffran's and Griepentrog's (2001) proposition that infants may be born with AP.

7.5.2.9. Tinnitus

Stanaway et al (1970) found no correlation between the AP judgment and tinnitus. But Costall (1985) reported musicians' feedback that tinnitus was used as anchors. In this study, there was no evidence that any of the subjects suffered from tinnitus. In naming five factors to develop AP, no one claimed comparing tones to the ear ringing sound as one of the factors. This study therefore is unable to shed any light on this possible association.

7.5.2.10. Chromesthesia

Some AP possessors had chromesthesia before AP (Vernon, 1977). Some AP persons related tones to colours (Petran, 1932; Costall, 1985). There is a query whether AP can be developed from chromesthesia. In this study, no subject reported having chromesthesia. No one claimed that AP was developed from chromesthesia. This study has been unable to show any evidence supporting the claim that AP may be correlated with chromesthesia.

7.5.3. Correlation of Age, Age of Commencing Piano Playing, Duration of Playing Piano, Piano Standard, Time for Practising Piano and Frequencies of Using AP to AP Achievement under LCK MusET

Concerning the 122 AP1-10 subjects, the multiple correlation coefficient (R=.630) showed that the subjects' age, age of commencing piano playing, duration of playing the piano, latest piano grades, time for practising the piano and frequency of using AP were predictor variables of the AP achievement. The effect size, R=.6, was great (Cohen, 1988). The ANOVA table showed the similar result that these six variables were significant predictors (F=32.69, df=6, 115, p=.000).

The regression coefficient table showed that the AP1-10 subjects' latest piano grades (t=3.88, p=.000), frequency of using AP in music activities (t=2.85, p=.005), time for practising the piano (t=2.86, p=.005), duration of playing the piano (t=2.23, p=.027) and age (t=-2.11, p=.037) were significant predictor variables of AP attainment. All were positively correlated to AP attainment except age. Age of commencing piano playing was not correlated (t=1.37, p>.05). This implies that the higher their piano grades, the more time they spend on practising the piano, the more frequently they use AP in music activities, the more time they play the piano, the younger their age, the higher will be their AP scores.

7.5.4. Codetta

Conclusively, the activities in LCK MusET, such as associating tones to absolute solfège, the accurate piano tuning, using AP in playing the piano, playing the piano from memory, sight-playing, singing, sight-singing, music listening, composing, conducting and learning music theory are determining factors of AP. Other influencing factors are the duration, piano standard, interest of playing the piano and attention. Other criteria, such as the gender, aptitude, age of onset, tonal language background, acute memory for pitch, auditory sensitivity, pitch identification training, inheritance, tinnitus and chromesthesia are not shown to be important factors by this study. Thus, LCK MusET is an effective instructional method enabling students to develop AP.

7.6. Time and Grades Needed to Develop AP under LCK MusET

7.6.1. Time Needed to Develop AP

AP persons usually recognize the trait at their early music experiences (Profita & Bidder, 1988; Slonimsky, 1988; Tervaniemi et al, 1993). AP reveals when they learn the musical scale and naming (Bachem, 1940, 1955; Hall, 2002; Shiel, 2002).

In this study, from the 17 (11.8%) subjects having played the piano for one to two months, nine (52.9%) subjects attained to AP1 or higher, with a mean AP score of 16.21%. One could get as high as AP7. All other subjects playing the piano longer than this period got mean scores even higher than this, ranging from 18.32% (SD=12.47) at 9-10 months to 92.61% at seven years. The longer they played the piano, the higher AP scores they would get (rho=.68, df=142, p=.000, 2-tailed). So, students can start to develop AP in as little as one to two months of learning the piano.

From the 122 AP1-10 subjects' feedback, 8.2% (N=10) of AP1-4 and 10.65% (N=13) of AP5-10 reported that their AP revealed within one to two months of their piano tuitions. The shorter the time AP revealed, the higher would be their post-test scores (rho=-.17, df=120, p=.30, 1-tailed). Their reports supported the experimental finding. A short development time signifies that AP starts to develop within a short period of time. If the tone-absolute solfège input is strong, the development time will be short. If the AP input is kept up, AP grows to a higher level of attainment, like the acquisition of a skill (Annett, 1989).

The students who played the piano for two years got AP5 (with a mean AP score of 55.03% and a maximum of 92.61%). The students playing the piano for longer than two years were able to get better AP attainments. They reached AP8 or AP9 (maximum AP9 or AP10 respectively) when they played the piano for seven to eight years.

The findings support the research from Bachem (1940, 1955), Profita and Bidder (1988) and Tervaniemi et al (1993) that some AP persons notice their AP in their early experiences of learning tones and naming. But this study supplies more concrete data. Students may notice their AP through identifying one or few tones successfully. This signifies that AP starts to

grow. That AP can be developed in a short time implies that AP is an innate potential. It starts to flourish under the circumstances that the tonal-labeling input is strong enough. The LCK MusET is an appropriate method to facilitate the development.

7.6.2. Piano Standard Needed to Develop AP

As mentioned above, AP can be developed during AP musicians' early musical experiences (e.g. Profita & Bidder 1988; Tervaniemi et al, 1993). Students in this study were able to develop AP at the preparatory grade. From 60 (41.7%) preparatory grade students, 33 (55%) were AP1-4 and six (10%) were AP5-7, with a mean of AP2. Students higher than this grade got a mean of AP4 or higher. As their piano standards move up, their AP achievement would improve (rho=.79, df=142, p=.000). Students got AP5 or higher (maximum AP8) at grade three (with a mean AP score of 67.57%). The students higher than this grade were able to obtain an even better AP achievement, a mean of AP8 (maximum AP9 or AP10) at grade seven and higher.

Conclusively, students' AP starts to develop in the beginning of their piano learning under a saturated music environment with the tonal-label association. Once the trait is developed, it starts to grow. Students can attain to AP5 or higher in grade three. When their piano standards move up, they can attain even higher levels of AP.

7.7. Processing of AP under LCK MusET

The AP processing includes encoding strategies and the identification processes of note names and octave placements.

7.7.1. Encoding Strategies of AP

There has been some disagreement on how AP persons perceive and process AP (Ward, 1999; Macpherson, 2000). From the 110 responses of 64 AP5-10s, it was known that the main strategy (55.5%) is to associate tones to sol-fah names. It is the only approach taught in LCK MusET. The next one is to identify tones naturally without noticing how (25.5%). Most students are young. They may be unaware of how they identify tones. The third strategy is to associate tones to letter names (10%). Letter names are taught as a secondary

medium to label tones. To recognize tonal qualities is uncommon (5.4%). Tones have unique qualities. Students must have recognized them; otherwise they could not label them. They are too young to tell. To associate tones to the image of the keyboard (1.8%) and the stave (1.8%) are rare. Other methods, such as referring tones to an or many internal standards, ear ringing sounds, compositions, colours, scales, throat positions or words are not used. They are indirect and RP techniques. All subjects responded in the AP test by calling out sol-fah names. In the researcher's understanding, recognizing tonal qualities and comparing tones to internal standards are the verbal strategies of associating tones to sol-fah names. Concerning the AP5-10 group, 96.4% of the responses were verbal codes of associating tones to sol-fah and/or letter names, and only 3.6% were the pictorial codes of relating tones to the images of the keyboard and/or the stave. All of the AP1-4 subjects used the single strategy of the verbal code.

Almost all AP individuals (N=58, 100% in AP1-4 and N=61, 95.3% in AP5-10) used the single strategy of the verbal code and only three (4.7%) AP5-10 used the multiple strategies of verbal and pictorial codes. The finding is consistent with the supposition of Siegel (1972, 1974, 1977a, b), Siegel & Siegel (1972), Zakaay et al (1984), Takeuchi and Hulse (1993), Zatorre and Beckett (1989), Schlaug et al (1995), Nowak (1995), Marin and Perry (1999), and Ohnishi and Matsuda (2001) that AP possessors use mainly the single strategy of the verbal code. Only very few AP students (4.7%) use multiple strategies. Even though the verbal encoding strategy was the main processing strategy, SD subjects did not get a significantly lower mean AP score than that of normal speech subjects ($t=1.629$, $df=107$, $p>.05$, 2-tailed). This is contrast to what Miller (1989) has suggested that musical savants with language problems are unlikely to make tonal-verbal association in the AP development.

One AP2 indicated that she compared tones to internal standards. She was an adult and had learnt to play the piano for only three to four months. She could not get rid of RP in such a short time. She used both AP and RP before developing true AP. No RP strategy was found

in other students, even in new comers of primary or secondary students. All new students are trained to develop AP through the absoluteness of tones. No intervals or tonal relationship are taught in beginning levels. Absoluteness in tonal recognition can override relativity in the music study in schools and in the music learning outside MusH, so that every student can develop AP.

7.7.2. Identification Process of Note and Octave Designations

AP possessors usually identify tone names and then octave designations in a two-way process (Miyazaki, 1989; Takeuchi & Hulse, 1993). Half of the AP5-10 students, (50.81%) identified tone and octave names simultaneously. In another half (49.19%), they identified note names and then octave designations. The AP1-4 students demonstrated a similar process too with 53.55% identifying note and octave names simultaneously, and 44.76% in identifying note names before octave placements. Nearly all (N=61, 95.3%) AP5-10 subjects used both strategies of either identifying note names before octave designations or identifying note and octave designations simultaneously. Three (4.7%) used one technique of identifying note and octave names simultaneously. Most (N=45, 77.6%) AP1-4 subjects used both strategies. Nine (15.6%) identified note and octave names simultaneously.

The findings are different from what Miyazaki (1989) and Takeuchi and Hulse (1993) have found. The subjects in this study identified both note and octave names simultaneously and one after another for half of the cases respectively. It was observed that students recognize tone and octave names simultaneously in their familiar regions, i.e. the middle registers. It is beyond the middle registers that they recognize tone names and then octave designations. They are taught to recognize tone and octave designations as a whole tonal individuality. They manage both solfège and octave signs well.

It was further found that the AP1-10 subjects of two to six years of age identifying note and octave designations simultaneously got significantly higher mean AP scores than that of the seven to 25 ($F=.45$, $df=1, 118$, $p=.037$). As young children perceive tones with octave designations as a whole, they are inclined to name tones and octaves at the same

time. As children get older, they develop a separate concept of tones and octaves. They learn to name tones and octaves in two separate stages. To identify familiar tones, they are inclined to recognize tones with octave designations in one process. These results showed that the approach of identifying tones and octave names simultaneously helps them to recognize tones more correctly.

7.8. Accuracy in Tonal Judgment

7.8.1. Accuracy of Tones with or without Octave Designations

Miyazaki (1990) found that G is the most correctly recognized tone, followed by C, A, D, E, F and other black key notes. Miller and Clausen (1997) found the accuracy order for children is C, A, A#, E, D, C#, F, B, G#, D#, G and F#, and for adults is G, B, C, D, E, F, G#, F#, A, A, A#, D#, and C#. These lists ignore octave designations.

In this study concerning AP5-10 students, the middle C is the easiest note to judge among the 88 piano tones with right octave designations. The order of the first 13th notes is C_o, F_o, E_o, C^1, G_o, D_o, G_1, D_1, C^2, E^1, C_1 and C_2. The list includes mainly the white key notes in the middle region except C_2 and C^2. The first easiest 14th to 43rd notes are mainly white key tones of other registers. The $C\#_3$ is the most difficult tone to identify. The order of the 13th hardest tones to judge is $C\#_3$, Eb_3, B_4, Bb_4, Ab_3, $F\#_3$, Ab^3, E_3, $F\#^3$, $C\#^2$, Bb_3, Ab_2, and B_3. They are mainly the black key tones in the lowest register. The hardest 14th to 45th tones are mainly black key tones of other registers and some white key tones of the two extreme octaves.

Concerning the tonal judgment ignoring octave errors, the middle C is still the easiest to identify. The first 33rd easiest tones to identify are all white key tones within two octaves below and above middle C except $F\#_1$, and all Cs except C_3, the lowest C. The hardest tone to recognize is $C\#_3$, which still ranks the lowest in identifying tones with right octave designations. The most difficult eleven tones to judge are mainly the black key tones in the lowest register. The hardest 19th to 55th tones to identify are mainly black key tones of other registers and some white key tones in the two extreme regions.

Concerning the judgment of the 12 notes without octave designations, the order of tones from the most to the least familiar is C, G, A, D, B, F, E, Bb, F#, Eb, Ab, and C#. C and C#, like the tonal judgment with octave errors counted or ignored, are still the easiest and the hardest tones to identify respectively. The white key tones are apparently better judged than the black key tones. C is the easiest tone to judge, like the list for children by Miller and Clausen (1997). C# was found the hardest to judge in this and in Miller's and Clausen's (1997) list for adults. The white keys tones are apparently better judged than the black key tones in Miyazaki's (1990), Miller's and Clausen's (1997) and this studies.

In LCK MusET, middle C is the first tone to learn after a brief introduction of black key tones. C is logically the easiest tone to memorize. After the C, the order of accuracy is different in tonal judgments with or without octave placements. This is because 12 sets of piano books are employed. Each book has a different approach in the introduction of tones, even though all the books focus mainly on white key tones. Concerning the black key tones, the order from the most familiar to the least appears as F#, Bb, Eb, Ab and C# generally. This reflects the occurrence of these tones in the piano syllabus.

7.8.2. Accuracy of White and black Key Tones

It was commonly found that AP persons identify white key better than black key tones (Miyazaki, 1990; Takeuchi & Hulse, 1991; Miller & Clausen, 1997; Mottron et al, 1999; Ward, 1999). Miyazaki (1990) found the mean correct response to white key tones was 96.1% and to black key tones 89.2%. Takeuchi and Hulse (1991) found 90% and 75% correct for white and black key tones respectively. However, Marvin and Brinkman (2000) found no significant difference. Comparing the accuracy of judging the white and black key tones, subjects in this study had mean accurate tonal responses of 87.65% for white key tones and 65.28% for black key tones. The mean score for the white key notes was significantly higher than that of the black key tones (t=10.78, df=63, p=.000, 2-tailed). The findings are consistent with those stating the white key superiority mentioned above.

Under LCK MusET, piano instruction starts with learning black keys. It was thought that

students could identify the black key tones equally well as the white key tones. These results have shown differently. This may be because that the learning of black key tones in the early stages was insufficient as the white key tones appear far more than the black key tones in the western classical music (Takeuchi & Hulse, 1991; Simpson & Huron, 1994; Miller & Clausen, 1997). These findings further support the idea that students acquire AP through exposing themselves to music with the awareness to the tonal-verbal association rather than through the pitch identification training. Miyazaki (1988) and Takeuchi and Hulse (1991) employed the Early Learning Theory to explain the white key superiority. The researcher did not find support for this in this study.

7.8.3. Accuracy of Tones in Different Registers

It was commonly accepted that the tones in the middle region are the easiest to identify among all tones (Rakowski & Morawska-Bungeler, 1987; Miyazaki, 1989). It is the most familiar register to musicians. The highest and lowest extremes are the hardest to judge. Accuracy is particularly poor in the lowest rather than in the highest region (Corliss, 1973; Ohgushi & Hatoh, 1992). Comparing the accuracy of judging tones in different octaves of the AP5-10 subjects, the order of accuracy is C_o-B_o, C_1-B_1, C^1-B^1, C_2-B_2, C^2-B^2, C^3-B^3 and C_3-B_3. The middle register is the best identified region. The lowest and highest extreme regions are the hardest to identify. Concerning the accuracy of the lowest and the highest regions (A_4-A_3 and C^3-C^4), and the rest of the regions (Bb_3-B^3), their mean AP score in the lowest and highest regions was significantly lower than that of the other registers (t=12.90, df=63, p=.000, 2-tailed). These two extremes are the most difficult to identify. In these regions, the "tone chroma" disappears while only the "tone height" exists and it is difficult for one to recognize tones with the vague "tone chroma" (Bachem, 1955). The finding is consistent with those by Corliss (1973) and Ohgushi and Hatoh (1992).

Comparing only the accuracy of the lowest (A_4-A_3) and the highest (C^3-C^4) octaves, the AP5-10 subjects' mean AP score of the lowest register was significantly lower than that of the highest one (t=-10.88, df=63, p=.000, 2-tailed). Students find it more difficult to

identify tones in the lowest region than in the highest. The finding is consistent with the findings of Corliss (1973) and Ohgushi and Hatoh (1992).

Under LCK MusET, the piano books are arranged to contain music with tones spread over the entire piano range, at least not always consisting of tones in the middle region. In fact, not many piano method books fulfill this requirement. In the pitch identification training, the tones in all regions are practised, even though the training starts in the middle region. The piano tuner is asked to tune all the piano tones in tune. All students are encouraged to tune their pianos by this contracted piano tuner. Results showed that even though students can identify tones of all regions, the accuracy of the outer regions is still worse than that of the middle region. It is under the influence of the piano textbooks and western classical music that most music is composed in the middle region (Miyazaki, 1989).

7.8.4. Octave Errors

Octave errors are common in AP possessors (Ward & Burns, 1982; Demany & Armand, 1984; Costall, 1985; Miyazaki, 1989). In this study, the 59 (92.2%) AP5-10 subjects made one to 47 octave errors out of the 88 judgments. Five (7.8%) made no octave errors. There were 17.49% of answers with octave errors and 61% without. The percentage of octave errors is considered small (with a difference of 43.51%). Octave errors are unavoidable because the tones of the nearest octaves share common overtones (Bachem, 1955; Ward & Burns, 1982). With the AP1-4 group, 14.36% of answers were with octave errors and 21.42% without, with a difference of 7.06%. The AP1-4 subjects had 36.45% more octave errors than the AP5-10. This showed that octave errors can be improved if AP improves.

Another cause for octave errors is the misapprehension or ignorance of octave designations. Most music students discriminate tones within an octave. Tones of other regions are identified like the ones in the same octave. Octave designations are neglected. There is no standardized system for musicians to assign octaves (Ward & Burns, 1982; Takeuchi & Hulse, 1993). In LCK MusET, note and octave names are taught simultaneously (refer to Section 3.2, p.108, and Appendices I.5 and I.6, pp.302-304 for the octave indications).

Students are taught to judge tones with sol-fah and octave names simultaneously. Tones carrying the same sol-fah name in different octaves possess different tonal qualities actually. AP is the successful attempt of the tonal-solfège with the octave designation association. Even though AP students make octave errors, the situation is believed having been improved.

7.9. Investigation on Non-AP

There is still the question of why some people can develop AP while others cannot (Halpern, 1989; Heaton et al, 1998; Zatorre et al, 1998). In this study, 22 subjects failed to develop to AP1 or higher at the time of the assessment. Twenty-one (95.5%) were associated with a combination of factors including: playing the piano at the beginning level (N=21, 95.5%), having attention deficit or short attention spans due to their age, learning difficulties or unstable emotions (including ten 2-3 year old children, 45.5%; seven SEN, 31.8%; and one MS, 4.6%), practising less than three hours a week (N=17, 77.3%), being new (N=15, 68.1%), having no or little interest in playing the piano (N=15, 68.2%), not singing solfège in practising the piano (N=4, 18.2%), playing out-of tuned pianos (N=2, 9.1%) and practising the electronic piano (N=2, 9.1%). One autistic subject, playing the piano for two years and attaining to grade two, failed to achieve to AP1 or higher because he had emotional and attention problems during the AP test. In fact, 18 AP0 got 1.14% to 9.09% marks in the AP test. They had made one to six right judgements. Compared g to the zero mark in the pretest, they actually started to develop AP. They might need longer time to achieve AP1 or higher.

7.10. Value of AP

It is universally accepted that AP helps to identify tones, intervals, chords and keys, to produce tones and tune instruments without a reference tones (Révész, 1953; Bachem, 1955; Siegel & Siegel, 1977; Marvin & Brickman, 2000). Other values are arbitrary.

7.10.1. Value in General Music Activities

From 122 AP1-10 subjects, 121 (99.2%) thought that AP was useful in learning music. Of

participants in related activities, all commented that AP helped them to identify notes, play the piano, playing the piano from memory, sight-play, sing, listen to music and conduct. Nearly all participants reported that AP helped them to sight-sing (98.7%), learn music theory (98.6%) and compose music (90%). Fifty-three (43.4%) subjects had experiences in playing back music after hearing. A total of 79.2% (N=42) of them reported that they could do it if the music was within their piano standard. The advantages of AP are identifying tones, chords, keys and notes of different parts. They are consistent with the findings of Révész (1953), Bachem (1954), Ward (1963), Miller (1989), Eppstein (1997), Siegel and Siegel (1977), Levitin (1998), Dowling (1999) and Marvin and Brickman (2000). That AP helps piano playing has been indicated by Collier (1983) and Slonimsky (1988). AP also helps one to memorize music. Music heard can be memorized and played back. This is consistent with the findings of Bachem (1955), Brown (1999) and Chang (2003). AP helps in sight-reading and score reading which is supported by Eaton and Siegel (1976), Miyazaki (1992, 1993) and Chang (2003). AP helps singing in tune and sight-singing according to Révész (1953), Eaton and Siegel (1976), Miyazaki (1995), Dowling (1999), Burns (1999) and Dickson (1999). Miyazaki (1992, 1993) and Brown (1999) have suggested that AP helps a person to notate and compose music. AP may even help a person to conduct music in tune. This is consistent with Révész's (1953) and Miyazaki's (1993) viewpoints. Furthermore, students pointed out that AP helps them to learn music theory too. From the researcher's experience, AP can help in the above-mentioned ways.

7.10.2. Fast Progress in Piano Performance

Grade three piano students (N=13, 10.7%), who practised the piano for a mean of five to six hours a week, took a mean of two years to achieve to this grade and passed the ABRSM grade three piano practical examination. Grade five students (N=4, 3.3%), who practised the piano for a mean of five to six hours a week, took a mean of three years to attain to this grade and passed the ABRSM grade five piano practical examination. Grade eight students (N=2, 1.6%), who practised the piano for a mean of three to four hours a

week, took a mean of five years to advance to this grade and passed the ABRSM (N=1) or TCL (N=1) grade eight piano practical examination. Diploma students (N=7, 5.7%) who practised the piano for a mean of five to six hours a week, took a mean of five years to attain to this grade and passed either the DipABRSM (N=2), ATCL (N=1), or the ABRSM (N=3) or TCL (N=1) grade eight piano practical examination, ready for the DipABRSM or ATCL. They (N=26, 21.3%) started to play the piano at a mean of the preparatory grade.

Ericsson et al (1993) found that the best violin students of performance majors in the music conservatory spent a total of 10,000 hours in practising the instrument. The lower achieving students accumulated about half of that amount. In the present study, diploma students took five years to get the DipABRSM or ATCL or to be ready for them. These examinations are equivalent to the completion of year one of music majors at the university level. The students accumulated 1300 to 1560 hours practising the piano. They spent 3440 and 8440 hours less than those low and high achievers respectively to attain to the diploma level. Their progress was three to six times faster than that of other music students. They possessed AP with a mean score of 85.47%.

From the researcher's point of view, it appears that they benefited from AP. Under LCK MusET, AP is a medium in perceiving and memorizing piano music. From singing or thinking of absolute solfège, students get a fuller understanding of music expressions, tempo and rhythmic sense, not to mention the tonal and key relationships. They sing loudly and play loudly. They sing fast and play fast. They sing expressively and naturally play expressively. Through singing and playing, they develop a better awareness to tones and a better involvement with music. If they can identify tones at the early stage of learning, they will develop more interest and achievement in music. Their parents would be more eager to involve and invest their children into this field (Gregersen et al, 1999; Baharloo et al, 2000). Under LCK MusET, AP is not an independent ability, but an indispensable component in the music learning. With it students seem to progress fast in learning to play the piano (Collier 1983, Slonimsky, 1988; Hall 2002) and have high achievement in the

piano performance (Révész, 1925, 1953; Slonimsky, 1988; Willet, 2001; Hamer, 2001).

7.10.3. Good Memory Ability in Piano Performance

Out of 107 subjects who had experiences in playing the piano from memory, over half of the students (N=71, 66.4%) reported that they could play the music from memory immediately after they had practised the music well with sight. These pieces of music are those in the piano syllabus, examination syllabus or competition repertoire. For those who could not play the music from memory at the first attempt, 55.6% (N=20) practised less than six times to memorize it. Most of them (N=83, 68%) could play one to three pages from memory in the first or first few attempts. Grade five students could memorize pieces of 10 to 12 pages. The long pieces were the piano sonatinas by Mozart, Beethoven, Clementi, Diabelli, Gurlitt, Kuhlau or Dussek. The grade eight or diploma students could play from memory pieces as long as 14 pages after they had practised the music well for two to three weeks. These pieces were from the repertoire of examinations, open competitions or the piano syllabus. They were sonatas or difficult long pieces by Handel, Haydn, Mozart, Beethoven, Schubert or Chopin. These processes were under the witness of the researcher and their parents. It was further found that the higher the students' piano grades, the longer the music they could memorize (X^2=137.55, df=36, p=.000, 2-sided), the more times they needed to memorize the music (X^2=70.53, df=45, p=.009, 2-sided) and the higher would be their AP achievement (r=.70, df=120, p=.000).

The memory that students develop is called the "video-camera-type-of-memory", the memory model named by the researcher. When they practise the piano, the notes are shot into the memory system like images through vision, and at the same time, the tones are recorded into the memory system like tape-recorders through singing and perceiving absolute solfège. They develop this kind of memory during the daily piano practice. Refer to Section 3.3**,** pp.109-111 for the piano practice method. In the whole process, AP is an inevitable agent.

Forty-two subjects had experiences in playing back music after hearing. A total of 79.2%

of them reported that they could do this if the music was within their piano standard. Some of them played back in front of the researcher. This suggests that AP can help them to memorize and play back the music (Brown, 1999). This supports claims that AP can help musicians to develop excellent memory for music (Slonimsky, 1988; Krieger, 1997).

7.10.4. Defence for AP

Some investigators viewed AP as a disadvantage rather than a help (Krieger, 1997). Some claim that it is disturbing (Weinent, 1929, cited in Petran, 1932). It is a nuisance (Sundberg, 1991). AP possessors are weak in RP tasks (Baggaley, 1974; Burns & Ward, 1978; Burns & Campbell, 1994), find difficulty with unconventional scales (Cuddy, 1977) and feel confused in playing a piano with a different tuning (Planck, 1893). AP possessors may find it hard to transpose (Wallaschek, 1892, cited in Petran, 1932), may not be good in improvisation (Weinent, 1929 cited in Petran, 1932) and may sing out of tune (Abrams, 2001). AP composers may not compose better than the non-APs (Parncutt & Levitin, 1999). It does not help in aesthetics (Halpern, 1989); Miyazaki, 1992, 1995). It has no musical advantages (Davis, 1978). It is not essential to music (Dowling, 1999). It is not a condition for musical talent (Révész, 1953; Sundberg, 1991; Dickinson, 1999; Weinberger, 1999). Tonal relationship is what music is composed of. RP is essential in music instead of AP (Takeuchi & Hulse, 1991; Miyazaki, 1995). So AP is not important as a musical ability except in identifying isolated tones, chords and keys.

Nevertheless, there is no doubt that AP helps in identifying tones (Ward, 1963; Macpherson, 2000), melodies (Petran, 1932), intervals (Miller, 1989; Levitin, 1998), tones of different voices (Eppstein, 1997), chords (Slonimsky, 1988; Marvin & Brickman, 2000), harmonic progressions, tonal relationship (Hantz et al, 1997; Siegel & Siegel, 1977) and key relationship (Révész, 1953; Dowling, 1999). The identification itself is a musical ability. Music listening, appreciation and analysis do not always have scores in hand or have referential tones. In extended pieces of music, skillful musicians may fail to trace out tones and lose tonal relationships. AP musicians may be weak in RP tasks, sing out of tune,

not good at improvisation, transposing or composing and so forth. All these weakness may occur in RP musicians. RP musicians may not find these things easy to manage either. These are musical techniques which need extensive training. It is a matter of training rather than the obstacle from AP.

AP possessors feel upset in hearing music out of tuned or in different tunings. Out of tuned music should not exist. It is the responsibility of performers to play music in tune. APs should not be the ones to blame. If everyone had AP, all the music played would be in tune. If AP musicians feel difficulty in unconventional scales, the similar difficulty would be experienced by RP musicians. Concerning the music tuned differently from A440, there is not much music set in other tunings nowadays (Chang, 2003). The situation has been improved since the concert pitch of A440 has been set up.

Moreover, AP persons can manage both AP and RP properly (Miyazaki, 1993). There are numerous researchers reporting that AP musicians or AP possessors who possess exceptional music abilities. They can learn to play instruments at an early age (Révész, 1925, 1953; Slonimsky, 1988; Hall, 2002) and progress fast (Collier, 1983; Slonimsky, 1988; Willet, 2001; Hamer, 2001; Hall 2002). They have excellent memory for tones, chords, melodies and music (Slonimsky, 1988; Krieger, 1997; Willet, 2001). They can play back music just heard (Richet, 1900, cited in Shuter-Dyson & Gabriel, 1981; Révész, 1925, 1953; Rutz, 1996), transcribe music (Krieger, 1997; Hamer, 2001) and analyze complicated chords from hearing (Révész, 1925, 1953). They can transpose and compose music at young age (Révész, 1953). They have high achievement in performance (Révész, 1925, 1953; Slonimsky, 1988; Willet, 2001; Hamer, 2001), composition (Révész, 1925, 1953; Willet, 2001; Hamer, 2001) and improvisation (Révész, 1925, 1953; Collier, 1983; Slonimsky, 1988). Music savants with AP are able to do all the things mentioned above (Minogue, 1923; Rife & Synder, 1931; Owens & Grimm, 1941; Scheerer et al, 1945; Anastasi & Levee, 1960; Paulson et al, 1967; Viscott, 1970; Charness et al, 1988). Therefore, AP is not a hindrance to develop musical skills, including RP, which are

emphasized in western music. On the contrary, AP, which can elicit other musical talents, is an essential musical talent itself (Brown, 1999). It has musical advantages and is an important component of musicality (Slonimsky, 1988; Baharloo et al, 1998). Whether AP is the isolated ability of identifying and producing tones without reference or an important component in musicality solely depends on how it is used. Under LCK MusET, AP is a musical talent itself, and is a crucial agent in developing other musical talents too. It exerts help to students in playing instruments, memorizing music, sight-reading, singing, sight-singing, music listening, conducting, composing, learning music theory, not to mention identifying tones.

The subject who thought that AP did not help her to learn music was a new student with moderate HI. She thought that she could not hear, play the piano and develop AP well. In fact, she started to develop AP and attained to AP1.

7.10.5. Vote for AP

All (N=144) subjects agreed that AP should be put forward continuously at MusH. The votes further support the value of AP.