

The distribution of Kolb's learning style in college students from different family backgrounds

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ABSTRACT

From existing learning style models, evidence for the influence of Kolb's Learning Style Inventory (LSI) is the most extensive. However, the distribution of Kolb's Learning Styles across individuals from different family backgrounds, as well as the association between Kolb's Learning Style and family background has not yet been reported in a population of college students. Participants (n=108) completed a demographic and family background questionnaire and the Honey and Mumford's Learning Styles Questionnaire (LSQ). The distribution of Learning Styles was characterized, together with the association between Learning Style and family background, using descriptive statistics and bivariate correlation analysis. These results show that the distribution of Learning Styles across a cohort of college students was consistent with previous findings. In addition, these findings also point to an association between Learning Style and family background, and as such, college students' preferences for learning style may be related to their family background. These findings have definite reference value for future research in this field.

Keywords: Distribution, College students, Learning style, Kolb, Family background

Introduction

Learning is described as the act, process, or experience of gaining knowledge or skill, while style is a quality of imagination and individuality expressed in one's actions and tastes. Learning style is a term used to express individual differences in the processes of learning, including the way by which a learner begins to focus on the process to absorb and retain information [1]. A person's learning style is a relatively stable pattern of behavior and is based on their background and experiences [2]. Learning styles have attracted the attention of researchers, educators, students, and parents of students over the past decades [3]. Deep and systematic research has been conducted into problems related to learning,

and both theoretical and empirical findings have been widely used in the field of education. Coffield *et al.* (2004) conducted a literature review citing findings ranging from the early 20th century to 2004 and found 71 models of learning styles [4]. These models can be divided into five categories: constitutionally based learning styles and preferences, cognitive structure, stable personality types, "flexibly stable" learning preferences, and learning approaches and strategies [5]. There are 13 highly influential models, including Kolb's Learning Style Inventory (LSI), Honey and Mumford's Learning Styles Questionnaire, Cognitive style analysis, and the Myers-Briggs type indicator. Among these, arguably the most influential is the LSI. Statistical reports indicate that 4,400 articles relating to the LSI (including Experiential Learning Theory, ELT) were published between 1971 and 2019 [6], with an average of 92 research outputs published on LSI each year. The use of LSI is widespread and the instrument itself has been translated into Arabic, Chinese, French, Italian, Russian, Spanish, and Swedish [4].

Kolb describes learning as the process whereby knowledge is created through the transformation of experience, resulting from the combination of grasping and transforming experience. He

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asserts that learning is also a holistic process of adapting to the world, and integrating thoughts, feelings, perceptions, and behaviors [7]. In the summer of 1966, Kolb devised ELT based on the existing theory created by John Dewey, Kurt Lewin, Jean Piaget, Carl Jung, and Carl Rogers. In particular, he was inspired by Carl Jung's theory of psychological types [4]. ELT outlines learning to be the process whereby knowledge is created through the transformation of experience. ELT helps to explain how experience is transformed into learning and reliable knowledge. A key feature of ELT is the mode of the experiential learning cycle, comprising four nodes: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). Kolb characterizes these four nodes thus: CE relates to learning from specific experiences, relating to people, and being sensitive to feelings and people; RO

relates to carefully observing before making judgments, viewing issues from different perspectives, and looking for the meaning of things; AC relates to logically analyzing ideas, planning systematically and acting on an intellectual understanding of the situation; AE relates to showing an ability to get things done, taking risks, and influencing people and events through action. The four nodes are assigned to the points of a compass, such that CE is "north", RO is "east", AC is "south", and AE is "west". Kolb describes the process of experiential learning in terms of this four-stage cycle, where these four nodes comprise the four learning modes and specifies a label for each mode, as follows: CE is feeling, RO is watching, AC is thinking, and AE is doing. These four labels reflect an individual's preferred direction for personal learning (**Figure 1**).

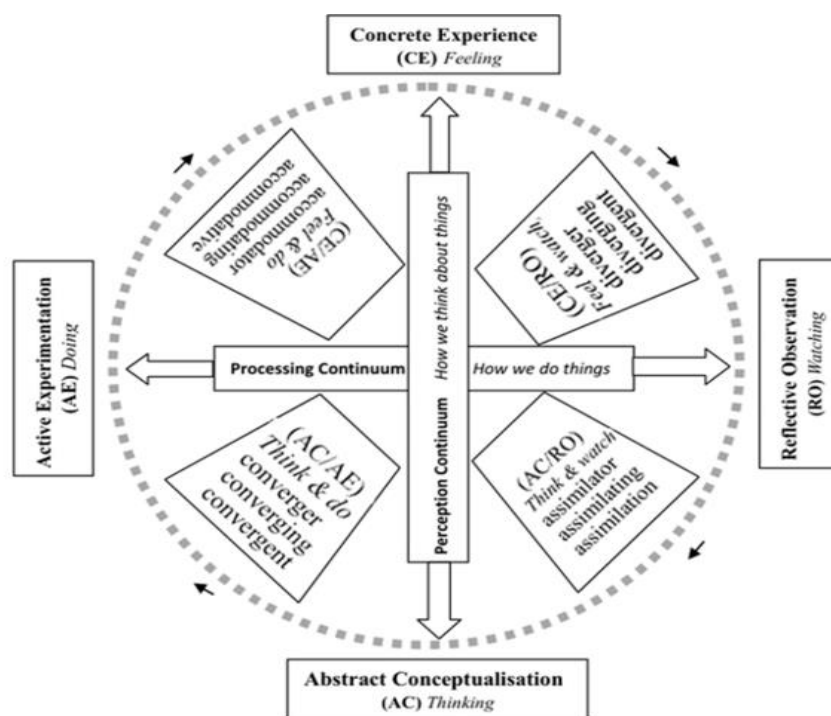


Figure 1. Kolb's experiential learning theory and learning style

Based on this four-cycle model, Kolb proposed a method of learning style evaluation based on an individual's unique combination of preferences for CE, RO, AC, and AE. This forms a profile in the form of a "kite" shape and facilitates the identification of the individual to one of four types of LSI learning styles, namely diverging (CE/RO), assimilating (AC/RO), converging (AC/AE) and accommodating (AE/CE). Divergence signifies a reliance on apprehension transformed by intention; assimilation represents comprehension transformed by intention; convergence is the extensive transformation of comprehension; and accommodation is the extensive transformation of apprehension [4]. Similarly, Kolb also carries forwards the above labels to the four learning styles, such that diverging is feeling and watching, assimilating is watching and thinking, converging is doing and thinking, and accommodating is doing and feeling. The LSI is an inventory of learning styles, designed and revised by Kolb with a theoretical basis in ELT. The first version of the LSI

appeared in 1976, the second in 1985, the third in 1999, and the fourth in 2012 [7]. The first version of the LSI comprised a brief questionnaire consisting of nine rows of four words which are to be ranked in order. The words in each row correspond to Kolb's four nodes (or learning modes): CE, RO, AC, and AE. The second version consisted of 12 sentence-completion items in which respondents attempt to self-describe their learning styles. In 1982, Mumford and Hone, based on Kolb's ELT, combined their own research and practical experience to develop the Learning Styles Questionnaire (LSQ) to match and improve the application of LSI. The LSQ is a questionnaire comprising 80 items, with the outcome of this questionnaire corresponding to the four nodes. Thereafter, the LSI produced outcomes using the established concepts of CE, RO, AC, and AE in the format CE/RO, AC/RO, AC/AE, and AE/CE [7], to produce the final "learning style" model (**Figure 1**). In the 2005 revision, Kolb's learning model classification increased from four nodes to six, with the addition

of AC/CE and AE/RO, and finally to nine. These final nine classifications are: initiating style, experiencing style, imagining style, reflecting style, analyzing style, thinking style, deciding style, acting style, and balancing style [7]. Subsequently, the four basic learning styles devised in Kolb's LSI have been referred to in the literature using three different sets of terms: (1) diverger, assimilator, converger, and accommodator; (2) divergent, assimilative, convergent, and accommodative; (3) diverging, assimilating, converging, and accommodating. However, these terms only differ in semantics. For consistency, this article will use set (1), see **Figure 1**.

There were 4,400 officially published outputs from studies using the ELT and LSI numbered between 1971 and 2019 [6], spanning over 30 disciplines, including education, agriculture, computer science, engineering, biology, economics, geography, medicine, physics, and psychology [7]. One study used the LSI to classify 241 medical teachers, medical students, and residency doctors and found that the majority of the residency doctors to be of the assimilating style [8]. In a survey of 204 undergraduate medical students, 47% were found to be assimilating. Such students learn through inductive reasoning, focus on abstract ideas and concepts, and have the ability to create theoretical models by assimilating disparate observations into a coherent and cohesive explanation [9]. Amod & Brysiewicz (2019) reported that teachers adopt experiential teaching strategies to improve the quality of teaching by applying human body simulators in nursing teaching, with good results [10]. Also, researchers developed a tool using the concept of experiential learning that tracked the impact of the tool in 12 cases. Experiential learning has been introduced into innovative education [11].

In 1975, Kolb reported that students with humanities and liberal arts backgrounds were more likely to be divergers; while business administration students were often accommodators; students with applied science backgrounds were typically convergers, and students with backgrounds in pure science, mathematics, and law were typically found to be assimilators. Other studies have found statistically significant associations between students' learning style preferences and academic achievement [12]. One study reported the adoption of experiential learning methods and applied human simulators to the teaching of midwives, which played a positive role in the interactions between students and teachers and the improvement of the learning effect [13]. Although some studies have found the LSI to have low reliability and construct validity. However, some studies have identified that in multiple learning theory and learning style models, Kolb's experiential learning model and the LSI are found to be the most prominent theory and most commonly-used instrument. It has been reported to use a particular form of experiential learning teaching to stimulate students' own involvement in the integration of their thoughts, feelings, and attitudes [14]. Annette & Vince (2019) discusses the value of learning from a psychodynamic approach to experiential learning [15]. Two new learning formats have been suggested, that allow students to systematically acquire active-motivational competencies: self-inquiry-based learning and self-experience-based learning. Research findings indicate that SIBL and SEBL are promising

approaches for this purpose [16]. These findings taken together provide evidence for the validity and reliability of the ELT and Kolb's LSI.

Despite extensive previous research investigating the theory and applications of LSI, no study has yet reported the distribution of Kolb's Learning Styles across a population of college students from a variety of family backgrounds. This study aims to investigate the family backgrounds of a group of medical college students alongside their Learning Styles and investigate the association between Kolb's Learning Style and family background in this cohort. The findings of this study will influence the design of future research in experimental learning.

Materials and Methods

Study design

College students were recruited to participate in the questionnaire survey. Participants gave informed consent before participation. Participants were asked to give relevant demographic information (gender, age, and level of education completed), family background (birth order, guardians, level of education completed by their father and mother, family financial situation, and place of residence), and to complete the LSQ.

Setting

The study participants were graduates from several nearby medical schools who sat the resident training entrance examination at Shanwei Second People's Hospital in China between February 1 and July 28, 2021. Only students who were willing to participate in the study were included. Any participant who made lack of data completing the questionnaire was excluded.

Ethics

Students were informed that their participation in the study was entirely voluntary and gave informed oral consent. Students were assured that their information would remain confidential. The study protocol was granted ethical approval (reference: 20210201) by the Ethical Review Board at Shanwei Second People's Hospital.

Participants

A cohort of 108 participants completed the questionnaire study.

Instrument

The instruments used in this study were: (1) questionnaires capturing demographic factors and family background and (2) the LSQ [17].

Procedure

Data collection ran from February 1 to July 28, 2021, and analysis was conducted between August 1, 2021, and October 1, 2021.

The research procedure was as follows: first, participants completed the demographic and family background questionnaires; second, participants completed the LSQ; third, the research team collated the data, removed invalid responses, confirmed that the responses were complete and valid, and input the data into the computer, whereupon the data were analyzed using Statistical Package for the Social Science (SPSS) version 19.0 (IBM) and finally reported.

Data analysis

Data were pre-processed using Microsoft Excel 2007 to determine the completeness and validity of the data before importing into SPSS. Descriptive statistics were used to characterize the distribution, variability, and range of the data. Associations between family background variables and LSQ outcomes were assessed, focusing on the taxonomic data of family background and the associated LSQ classification, using a Bivariate Correlation (Spearman) analysis.

Results and Discussion

Demographic information

A total of 108 subjects participated in this study, of whom, 58 (53.7%) were men and 50 (46.3%) were women. The average age was 23.9 years, and the median was 24 years. The level of education completed was as follows: 2 (1.8%) had Master's degrees, 88 (81.5%) had undergraduate degrees and 18 (16.7%) had graduated from junior college.

Family background

Birth order

Following the methodology [18] used by Liu *et al.*, we divided the participants by birth order into (1) only children (OC; n=9; 8%), (2) one sibling (OS; n=28; 26%), and (3) multiple siblings (MS; n=71; 66%).

Guardianship

We divided the participants by their guardianship during childhood, as follows: growing up with their parents (GP; n=87; 81%), growing up with their grandparents (GG; n=14; 12%), growing up in a single-parent family (GS; n=2; 2%), and other (OT; n=5; 5%).

Parents' educational attainment

Paternal educational attainment was as follows: 2 (2%) had undergraduate degrees, 4 (4%) had graduated junior college, 32 (29%) had graduated high school, 52 (48%) had only completed junior high, 18 (17%) only primary school, and 0 were illiterate. Maternal educational attainment was as follows: 0 had undergraduate degrees, 4 (4%) had graduated junior college, 13 (12%) had graduated high school, 25 (23%) had only completed junior high, 64 (59%) only primary school, and 2 (2%) were illiterate.

Family financial situation

The family financial situation was divided into four levels: poor (an annual family income of less than \$12520), low income (an annual income of \$14085-\$23475), middle income (an annual income of \$25040-\$78250), and high income (an annual income of more than \$79815). Of the 108 participants, 22 (20%) were classified as poor, 72 (67%) low income, 12 (11%) middle income, and 2 (2%) high income.

Place of living

Participants' place of living was divided into (1) city (n=28; 26%) and (2) township or rural (n=80; 74%).

LSQ

LSQ distribution

The distribution of participants' LSQ outcomes is given in **Table 1**. Of the 108 participants, 64 (59%) were assimilators, 24 (22%) were divergers, 12 (11%) were convergers, and 8 (7%) were accommodators.

Table 1. Distribution of participants' LSQ style (n=108)

LSQ	Diverger	Assimilator	Converger	Accommodator
Number of people	24	64	12	8

Note. Honey and Mumford's Learning Styles Questionnaire = LSQ

LSQ and family background

The family background variables assessed for association with LSQ were birth order, guardianship, paternal education,

maternal education, family financial situation, and place of living. The associations between LSQ style and participant demographic characteristics are given in **Table 2**.

Table 2. Family background factors and LSQ style (n=108).

	Diverger	Assimilator	Converger	Accommodator
<i>Birth order</i>				
OC	0	6	1	2

OS	4	17	4	3
MS	18	41	7	5
Guardianship				
GP	19	54	9	5
GG	3	8	1	2
GS	0	1	0	1
OT	2	1	1	1
Father's highest level of education				
Undergraduate	1	1	0	0
Junior college	1	3	0	0
High school	9	16	3	4
Junior high	9	33	6	4
Primary school	4	10	3	1
Illiteracy	0	0	0	0
Mother's highest level of education				
Undergraduate	0	0	0	0
Junior college	1	3	0	0
High school	1	9	1	2
Junior high	5	15	4	1
Primary school	16	37	7	4
Illiteracy	0	1	0	1
Family financial situation				
Poor	5	14	1	2
Low income	14	44	10	4
Middle income	3	7	1	1
High income	2	0	0	0
Place of living				
City	7	13	4	4
Rural	17	51	8	4

Note. Honey and Mumford's Learning Styles Questionnaire = LSQ

Only Children = OC One Sibling = OS Multiple Siblings = MS Growing with their Parents = GP

Growing up with their Grandparents = GG Growing in a Single-parent family = GS Other = OT

Considering birth order, 67% of OC participants were assimilators, which is 9% higher than MS participants. Conversely, 25% of MS participants were divergers, while no OC participants were divergers. 62% of GP participants were assimilators, and 14% of GG participants were accommodators. Considering parental education, 48% (52) of participants' fathers' had completed junior high, and among these, 33 participants were assimilators. Of the 64 (59%) of the participants whose mothers

had completed primary school, 37 were assimilators. Of the 67% (72) of participants from low-income families, 44 were assimilators. Of the 80% (n=80) participants from rural households, 51 were assimilators.

The distribution of LSQ style across participants with different family background factors is described in **Table 3** using the maximum, minimum, range, variance, standard deviation, and standard error.

Table 3. Family background factors and LSQ style (n=108)

	Maximum	Minimum	Range	Variance	Standard deviation	Standard errors
Birth order						
OC	6.00	0.00	6.00	6.917	2.630	1.315
OS	17.00	3.00	14.00	44.667	6.683	3.342
MS	41.00	5.00	36.00	272.917	16.520	8.260
Guardianship						
GP	54.00	5.00	49.00	496.917	22.292	11.146
GG	8.00	1.00	7.00	9.667	3.109	1.555
GS	1.00	0.00	1.00	0.333	0.577	0.289
OT	2.00	1.00	1.00	0.333	0.577	0.289

<i>Father's highest level of education</i>						
Undergraduate	1.00	0.00	1.00	0.333	0.577	0.289
Junior college	3.00	0.00	3.00	2.000	1.414	0.707
High school	16.00	3.00	13.00	35.333	5.944	2.972
Junior high	33.00	4.00	29.00	182.000	13.491	6.745
Primary school	10.00	1.00	9.00	15.000	3.873	1.936
Illiteracy	0.00	0.00	0.00	0.000	0.000	0.000
<i>Mother's highest level of education</i>						
Undergraduate	0.00	0.00	0.00	0.000	0.000	0.000
Junior college	3.00	0.00	3.00	2.000	1.414	0.707
High school	9.00	1.00	8.00	14.917	3.862	1.931
Junior high	15.00	1.00	14.00	36.917	6.076	3.038
Primary school	37.00	4.00	33.00	222.000	14.900	7.445
Illiteracy	1.00	0.00	1.00	0.333	0.577	0.289
<i>Family financial situation</i>						
Poor	14.00	1.00	13.00	35.000	5.916	2.958
Low income	44.00	4.00	40.00	317.333	17.814	8.907
Middle income	7.00	1.00	6.00	8.000	2.828	1.414
High income	2.00	0.00	2.00	1.000	1.000	0.500
<i>Place of living</i>						
City	13.00	4.00	9.00	18.000	4.243	2.121
Rural	51.00	4.00	47.00	456.667	21.370	10.685

Note.
 Only Children = OC One Sibling = OS Multiple Siblings = MS Growing with their Parents = GP
 Growing up with their Grandparents = GG Growing in a Single-parent family = GS Other = OT

The distribution of LSQ style with guardianship varied greatly, with GP participants showing the most highly represented style (n=54) and the least represented style (n=5) to differ by 49

participants. **Figure 2** shows the LSQ distribution with factors characterizing the participant's family background.

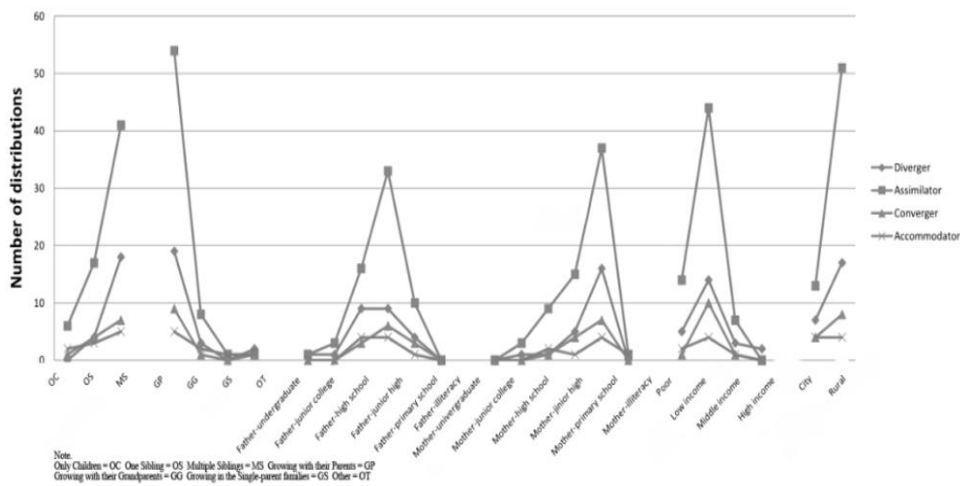


Figure 2. Distribution of LSQ in college student from different family background (n=108)

Figure 2 shows the greatest variation in the family backgrounds of assimilators, also with a wide range. The family backgrounds of accommodators vary the least with a relatively small range.

in **Table 4**. These figures represent the different strengths of correlation between family background factors and LSQ style, identifying which are statistically significant ($p < 0.01$).

The associations between LSQ style and family background factors

Results of the bivariate correlation (Spearman) analysis are given

Table 4. Associations between family background factors and LSQ styles (n=108).

	Diverger	Assimilator	Converger	Accommodator
<i>Birth order</i>	1.000**	1.000**	1.000**	1.000**
<i>Guardianship</i>	1.000**	0.949	0.949	0.949
<i>Father's education</i>	0.971**	1.000**	0.926**	0.926**
<i>Mother's education</i>	0.971**	1.000**	0.941**	0.785
<i>Family financial situation</i>	1.000**	1.000**	0.949	1.000**
<i>Place of living</i>	1.000**	1.000**	1.000**	0.000

Note.

Honey and Mumford's Learning Styles Questionnaire = LSQ

Two-tailed tests. ** $p < .01$.

As the version of the LSQ used in the present study was the one updated to the LSI, we will herein refer to the instrument as the LSI. The present findings using the LSI to assess medical college students are substantially in agreement with the one previous study in this field.

Of the cohort recruited, 59% were found to be assimilators, which is considerably higher than the proportion reported in previous studies. This may be related to differences in the cultural settings of the studies. For example, Jing and Zhao (2020) found 62% of a group of nursing students to be assimilators [19]. Medical students are likely to exhibit different learning styles to nursing students, in support of Kolb's view that the distribution of LSI type will vary with the area of specialty [20].

Participants from different family backgrounds showed different distributions of LSI style. For example, 58% of participants with MS were assimilators, and 7% were accommodators, whereas 40% of participants in the OT group were divergers, and 20% accommodators. Where the father's highest level of education was high school, 50% of participants were assimilators and 9% convergers, whereas, in participants where the mother's highest level of education was high school, 69% were assimilators and 8% convergers. In the families classified by income as being poor, 64% of participants were assimilators, and 5% were convergers. Of those living in the city, 46% were assimilators, and 25% were divergers. These findings echo those of Chen and Yang, who reported that gender, ethnicity, and family were found to influence the learning styles of nursing students [21].

As shown in **Figure 2**, for the distribution of LSI, assimilators represented the largest proportion of participants, regardless of family factors, followed by divergers, with the smallest number of participants being accommodators. Looking at birth order, the number of assimilators from MS families was greater than those from OC families. Looking at guardianship, the number of assimilators from GP families was greater than those from GS families. Looking at paternal education, the number of assimilators from families where the father's highest level of education was an undergraduate degree is fewer than those where the father's highest level of accommodation was junior high. Where the mother's highest level of education was primary school, there were more assimilators than where the mother's highest level of education was junior high. Looking at the financial situation, the number of assimilators from low-income families was greater than that from high-income families. There were

more assimilators from rural families than city-dwelling families. However, across the cohort of medical college students, the majority were assimilators, and the fewest were accommodators. Meanwhile, this distribution varied greatly with family factors. Our findings support those of Liu *et al.*, in that student learning style was predicted by individual factors such as age, learning experience, and the environmental factors of family, school, and society [22]. Although the present findings (**Tables 1-3**) are in agreement, further study is needed to confirm this effect.

From the ELT proposed by Kolb and the subsequent research and application of the LSI and LSQ, the development, maintenance, and presentation of individuals' LSI learning styles have been closely associated with to psychological development, the formation of personality, and thought habits [7], which in turn are closely associated with to an individual's family background. **Table 4** shows the correlations between different family backgrounds and LSQ outcomes. The previous findings of Li and Steven also indirectly support the findings from the present study [23].

In summary, the findings of this study are as follows: (1) the learning styles of college students from different family backgrounds are likely to be different; (2) individual college student's preferences for learning style may relate to their family background; and (3) college students' family backgrounds may impact their learning styles. These findings contribute to the growing bank of evidence characterizing the factors that influence learning style, the mechanisms by which learning styles develop, and any methods that may be used to cultivate specific learning styles in the future.

Limitations and future research

A limitation of this study is that these findings are reflective only of the college student population. While understanding learning styles in this population is crucial to the success of the next generation and the multi-billion USD higher education industry, these findings may not be generalizable to other groups. The sample size presented in the present study was relatively small, and participants were not sampled randomly or cross-sectionally. Bias may have been introduced into the data due to the ability of students to self-select whether to participate or not. Much work is still needed to understand college students' learning styles, including, but not limited to, empirical research to assess the

impact of family background on the development of college students' learning styles, and research into the biological mechanisms behind the development of learning style. This is crucial work requiring well-designed and well-resourced investigation, as the current methods for determining learning styles have been reported to produce less than optimal results [24].

Conclusion

Many previous research outputs have attempted to describe the distribution of learning styles, with the majority of research participants involved in such studies being Caucasian people. The present study crucially observed the distribution of learning styles in Chinese research participants, for which there is limited existing literature accessible internationally. The findings of our study are consistent with those of previous studies conducted in Caucasian people. Further, the present study also investigated the relationship between the distribution of the learning styles of the research participants and various characteristics pertaining to their family background. These findings shed light on the formation and distribution of the learning styles of Chinese people, suggesting that they may be related to family background. The present findings not only provide a new reference sample for future research in this field but also provide novel methodologies relevant to studying and improving the education and training of Chinese medical students.

The sample size used in the present study is limited, and as such, these findings justify future multi-faceted large-scale studies using novel data collection and analysis methods. The present findings demonstrate that the empirical study of the associations between human learning styles and neurobiology is of great interest to the research community.

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