

Computer-Mediated communication and the role of adolescence in language development

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Citation

M Collins, L Vinicius. *Computer-Mediated communication and the role of adolescence in language development*. The Internet Journal of Biological Anthropology. 2008 Volume 3 Number 1.

Abstract

This study explores the relationship between human language and changes in language use during adolescence. After reviewing current theories for the origin and evolution of language, the article tests the hypothesis that sexual selection played a vital role in the development of language by examining sexual dimorphism in language in a sample of adolescents of known age and sex. The analyses relied on computer-mediated communication and data from online journals, which provide an insight into changes in language use as a function of age and individual development in male and female adolescents. The study detected a significant amount of sexual dimorphism in written language in adolescence, although no significant change as a function of increasing age was observed; in other words, a significant fraction of sexual dimorphism in language was already present before the onset of adolescence. Our results did not support the hypothesis recently proposed by Bogin and Locke that the evolution of an extended human adolescence resulted from its possible crucial role in the development of sexual dimorphism in language. The results also indicate that computer-mediated communication is a useful tool in aiding our understanding of language evolution.

INTRODUCTION

HOW AND WHY DID LANGUAGE EVOLVE?

Symbolic language is one of the defining features of Homo sapiens, but it was not until the publication of Pinker and Bloom's 'Natural language and Natural selection' (1990)[₁] that research into the origins and function of language became a "legitimate area of scientific enquiry"[₂]. Symbolic language can be roughly defined as the communication of thoughts and feelings through a collection of arbitrary signals (vocalisations, gestures or written symbols) organised into higher-order units of meaning according to syntax rules[₃]. Although non-human animal communication systems may share certain properties with symbolic language, no other system comes close to the complex, flexible and cognitively sophisticated language of humans. Laboratory work with chimpanzees has shown that although they may be able to recognise words as referential symbols, they are unable to combine them into meaningful sentences or to describe more abstract entities such as emotional states[₄]. The reasons for the emergence and evolution of human language are controversial and have generated much debate[₅].

LANGUAGE AS AN ADAPTATION

Pinker and Bloom[₁] originally proposed that human language evolved by natural selection and rejected the idea that it could be a mere by-product of more general cognitive abilities such as 'general intelligence', 'symbolic capacity' or 'cultural learning'. The evidence for their claim can be summarised in five points. First, language is a universal phenomenon across all human societies, and all societies use language with a high degree of complexity and flexibility, despite stereotypes to the contrary[₆]. A second, perhaps more controversial point is that all languages seem to exhibit a universal design: compositional features of language such as phonemes, nouns, verbs and syntax can be found in all human languages according to linguists such as Chomsky[₇]. A third line of evidence drawing from studies of neurological and genetic disorders shows the dissociation between 'general intelligence' and language capacity. For instance, in aphasia and other genetically caused developmental syndromes known as Specific Language Impairment (SLIs), individuals display normal intelligence but have great difficulty in using and understanding language[₈]. Conversely, a number of disorders such as Williams syndrome greatly affect IQ and cognitive abilities without causing speech or grammar related problems[₉]. The

fact that linguistic ability and a more general type of intelligence can be dissociated has therefore suggested that “they are not manifestations of a single underlying ability”^[10]. The fourth line of evidence put forward by Pinker comes from the study of language acquisition amongst children that grew and developed in isolation from adults. These studies show that even in the absence of a pre-existing or culturally transmitted language children are able to quickly develop creole languages amongst themselves.

The fifth and perhaps most convincing argument derives from the development of language. Pinker notes that the stages of language acquisition amongst children are almost universal, and that the full command of language is achieved through a learning process involving first the taking of a finite sample of sentences from parents and others, and then the development of a grammar capable of generating an infinite set of sentences^[3]. For this reason, the errors present in the language of children from different societies tend to be highly systematic and can be shown to conform to linguistic universals^[11]. Together, the evidence outlined above suggests the existence of an innate and universal developmental program controlling language acquisition.

LANGUAGE AND THE HUMAN ‘COGNITIVE NICHE’

If language is an adaptation, it must therefore have evolved as a response to selective pressures. Based on the work of Tooby and Devore^[12], Pinker^[10] proposes that human language was the result of the need to gather and exchange information to fulfil our ‘cognitive niche,’ which includes other features such as tool manufacture and hypersociality. The cognitive niche theory argues that cause-and-effect reasoning evolved in humans in order to account for various domains of the world such as objects, forces, paths, places, and also for social factors such as manners, states, beliefs and desires of other people.

The cognitive niche theory also attempts to explain the evolutionary reasons for the relatively long period of growth and development of humans^[13]. Language would be an effective and ‘cheap’ way employed by mothers to convey accurate information to their offspring regarding dangers of the natural world, food attainment and preparation, and social interactions. Moreover, in contrast to other primates, bipedal locomotion and the relatively large size of human children meant that infants would no longer continuously hold on to their mother for protection^[4] and would have to be either riskily ‘parked’ for the day, or kept within close

contact and supervised with the use of vocalisations. Based on kin selection theory, Fitch^[14] extended the reasoning to suggest that adults would eventually help other related offspring by this ‘cheap’ means of communication thus expanding the social reach of language and promoting its generalisation in human populations.

LANGUAGE, SOCIAL GROUPS AND SEXUAL SELECTION

The ‘cognitive niche’ theory has nonetheless received criticism. Dunbar^[5] concluded that language is primarily used for gossip, with little to no technical or ‘cause-and-effect’ value. Dunbar does not dispute that language can be used to convey technical information, but suggests that language arose primarily to deal with social information exchange. Technological activities take up a relatively small proportion of our time, and when we do engage in them, language is rarely the preferred tool. Dunbar^[15] concluded that “language enables us to keep track of events in the community in a way our monkey and ape cousins simply cannot do: what they do not see, they can never know about”.

Additionally, the ‘cognitive niche’ theory of language may have incorrectly assumed that large and stable social groups existed before human language and made the latter possible; however, it is possible that language itself was the basic condition for the emergence of larger human groups. Dunbar^[5] showed that the amount of time required to maintain social groups as large as those found in human populations by means of grooming (a mechanism by which primates bond and maintain relationships) would be utterly impractical, and argued that the less time-consuming exchange of social information by means of language replaced grooming as the primary form of social bond maintenance in humans.

Miller^[16] proposed a second theory (the ‘Scheherazade Effect’) based on the social uses of language. The theory postulates that language evolved by sexual selection to advertise our suitability to prospective mates, much in the same way as a peacock’s tail. In Miller’s words, ‘verbal courtship can be viewed narrowly as face-to-face flirtation, or broadly as anything we say in public that may increase our social status or personal attractiveness in the eyes of potential mates...individuals are accepted or rejected as sexual partners on the basis of what they say.’

If language is a product of sexual selection an important consequence would follow: as in the case of peacock’s tail

(which is absent in the peahen), one would predict the occurrence of sexual dimorphism in human language. Geary^[17] pointed out that mate competition has induced the evolution of cognitive differences between sexes in many species. In humans, some studies have indeed presented evidence for sexual dimorphism in language use. Men are more likely to tease and put down their peers than women as exemplified in their attitude towards attainment of status^[18], more likely to spend time arguing or engaging in verbal dueling^[19], more vocal in courtship, more likely to interrupt females during conversation, and more likely to show off linguistic abilities^[20]. Women are more likely to engage in intimate conversation^[21] that often takes the form of gossip, bond-strengthening exchanges^[22] or coalition-formation against other females, and typically less likely to make the first courtship move, preferring to deploy behaviours such as nodding, smiling and reclining that encourage men to reveal information about themselves^[23].

LANGUAGE AND LIFE HISTORY

The theories of Dunbar and Miller imply that social interactions, especially between males and females, may have been a very important force behind language evolution. Since sexual dimorphism both in morphology and behaviour develops in particular during adolescence, this developmental stage might also be hypothesised to play a role in language dimorphism. According to Bogin and Locke^[20], although the basic structure and functions of language are established earlier during infancy and childhood, the complex aspects of language found in adults in their pursuit of status and sex could only evolve due to the extended period of learning provided by adolescence.

In relation to language, adolescence involves neuroendocrinological changes that differentially affect the human vocal tract and the fundamental frequency of the sexes^[24]. The critical variable in this transformation is testosterone that increases the length and mass of the vocal folds in men, thereby altering their vibratory characteristics and causing males voices to become deeper and lower in frequency^[25]. Further changes in linguistic communication during adolescence can be divided into four main areas: linguistic content (a general increase in vocabulary, grammatical operations and idiomatic phrases^[26]) delivery rate (an increase in speaking rate and fluency as a result of increased respiratory capacity and confidence^[27]), modification (creation of linguistic markers that modify and adapt the native language^[28]) and function (broad changes in use of language, including novel features such as joking,

deceiving, mollifying, negotiating, sarcasm social talking, or the relational use of speech in which the topic is frequently other people^[29]).

According to Bogin and Locke^[20], the new functions of language acquired during adolescence serve the function of establishing social status in adulthood. Verbal performances such as debating for example typically have an audience and may alter individual status in a group to change^[30]. It is interesting to note that across cultures, and particularly in traditional societies, verbal performances and competitions are usually dominated by men^[31] who may be more likely to place a high value on individuality and autonomy, as opposed to women who have been interpreted as being more inclined towards collectivism, intimacy and private communication^[32].

ADOLESCENT LANGUAGE AND INTERNET BLOGS

Despite their appeal, the lack of empirical evidence for the hypotheses outlined above has led to claims that they belong to the realm of “just-so stories”^[33]. Bogin and Locke^[20] from example relied on ethnographic accounts of a relationship between language proficiency, status attainment and courtship skills, but only gathered limited and mostly anecdotal evidence such as individual quotes from adolescents for their claim that language complexity and sexual dimorphism in language dramatically change over adolescence. A possible solution may be found in computer-mediated communication and internet ‘blogs’ or personal diaries accessible on the web. Blogs have been a particularly rich source of information due to their distinctive technological features^[34] such as user-friendliness, extensive archives and online communities.

Using data from blogs, Huffaker and Calvert^[35] have tried to directly assess differences in language use in male and female adolescents. Although levels of dimorphism were lower than expected, they revealed some gender differences with males employing a more active style of language. However, their study did not analyse subjects by age and preferred to pool together a sample of adolescents aged 13 to 17 years. For this reason, although the study points to gender differences in language, they may have been already present before its onset.

In order to investigate to which degree gender differences develop during adolescence, it would be crucial to analyse language changes as a function of age from the beginning to the end of adolescence. Data from blogs suit that purpose as

they offer a sample of adolescents from various ages, and allow us to follow the progress of one individual over time. In the following, we investigate the presence and development of gender differences in adolescent language through analyses of internet blog excerpts.

MATERIALS AND METHODS

SAMPLING

Blog authors tend to retain relative anonymity but often provide information on age and gender. The general consensus is that the majority of blog users are females and aged between the ages of 13 and 19_[35]. According to LiveJournal.com (the most used blog website), 67.3% of live journal users are female. Teenage online blogs were randomly selected from two providers: Opendiary.com (N=367) and Student.com (N=35). Individuals of a given sex and age can be found through the searching devices on these sites. Individual blogs were selected at random, although a preference was given to those with particularly high message counts and stretching over longer periods. Due to a smaller number of male users, the male sample of 137 individuals covers the ages between 13 and 18, with each year being represented by at least 20 individuals. The female sample ranges from 12 to 18 years, in a total of 267 individuals. Due to current efforts to protect the identities of blog users, data from younger age cohorts are not available and will not be used.

ANALYSES

Our analysis of adolescent language was based on excerpts from individual blogs. For each individual, 3 excerpts per year were taken at equidistant intervals (i.e. 1st April, 1st, July and 1st December). Each set of 3 excerpts was then analysed with the software package DICTION 5.0, which compares sampled texts with 33 built-in dictionaries that serve as standards of language. This study focuses on a subset of 10 variables: Average Word Size, Numerical Terms, Collectives, Aggression, Accomplishment, Communication, Spatial Awareness, Temporal Awareness, Human Interest, and Motion. In order to compare sexes and ages, we used ANOVA and Pearson's Correlations. DICTION also provides 'Master Variables' or indexes calculated from primary variables (that include both the subset of 10 variables listed above and other variables). The following Master Variables were computed:

$EMBLEMISHMENT = (Praise + Blame + 1) / (Present Concern + Past Concern + 1).$

$ACTIVITY = (Aggression + Accomplishment + Communication + Motion) - (Cognitive Terms + Passivity + Embellishment).$

$CERTAINTY = (Tenacity + Leveling Terms + Collectives + Insistence) - (Numerical Terms + Ambivalence + Self-Reference + Variety)$

$COMMONALITY = (Centrality + Cooperation + Rapport) - (Diversity + Exclusion + Liberation).$

Although DICTION defines the Master Variable 'Complexity' as a 'simple measure of the average number of characters-per-word in a given input file', we redefined it as:

$COMPLEXITY = Average Word Length + Embellishment.$

RESULTS

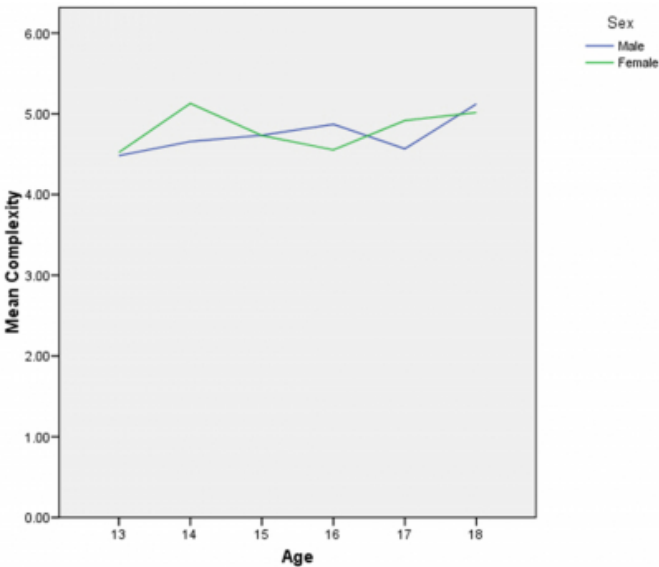
Based on the ideas of Dunbar, Miller, Bogin and Locke regarding the role of adolescence in language development, we discuss a set of five hypotheses concerning language use in adolescence:

Hypothesis 1: With age, an increase in COMPLEXITY of language use in both male and female adolescents should be observed.

No significant correlation between complexity and age for either boys ($r=0.12$, $P=0.17$) or girls ($r=0.02$, $P=0.75$) and no apparent difference between the sexes were observed (Figure 1). Therefore, we cannot reject the null hypothesis no apparent increase in language complexity occurs between the ages of 13 and 18.

Figure 3

Table 1: Correlations between male age and ‘male-like’ variables.

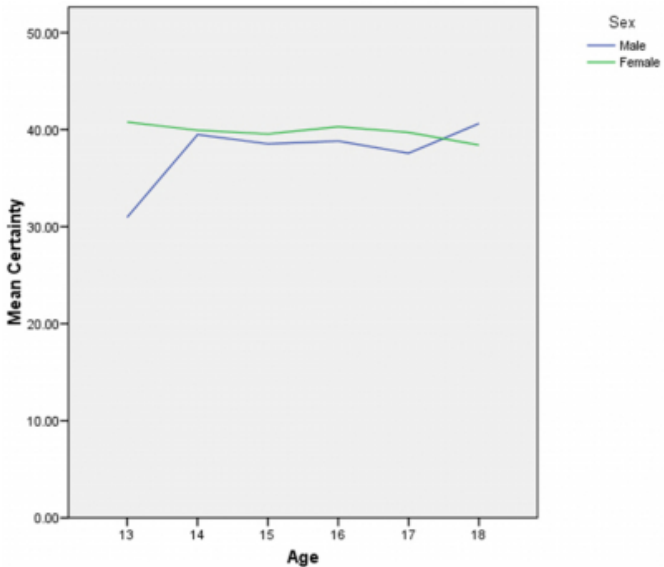


Hypothesis 2: With age, one predicts an increase in CERTAINTY in both males and females, indicating an increased confidence in language usage. Males should display greater CERTAINTY levels than females.

According to Dunbar, Bogin and Locke both males and females are expected to develop social aspects of language in adolescence, but boys who make more explicit use of language as a display tool should show higher levels of confidence. Confirming the prediction, data showed a significant correlation between certainty and age in males ($r=0.274$, $P=0.001$, $N=137$) but not in females ($r=-0.08$, $P=0.20$, $N=265$). In addition, there is a significant difference between males and females, but in contrast to our prediction values are higher in females (ANOVA, $F=10.7$, $d.f.=380$, $P<0.001$; see Figure 2).

Figure 2

Figure 2: Mean scores of Certainty by age in boys and girls.



Hypothesis 3: Males should exhibit higher values for NUMERICAL TERMS, AGGRESSION, ACCOMPLISHMENT, SPATIAL AWARENESS, TEMPORAL AWARENESS, MOTION and ACTIVITY.

For Numerical Terms and Accomplishment, scores were higher in boys than girls as predicted ($P<0.001$, $N=401$), but female values were significantly higher in the case of Spatial Awareness, contrary to the expectation. Also against the predictions, we observed no significant differences in Aggression ($P=0.70$), Temporal Awareness ($P=0.09$), Motion ($P=0.60$) and Activity ($P=0.27$).

Hypothesis 4: Females should yield greater values for: COLLECTIVES, COMMUNICATION, HUMAN INTEREST and COMMONALITY.

Human Interest scores were significantly higher in girls in comparison with boys ($P<0.001$), but no significant differences were found between sexes in the variables Collectives ($P=0.77$), Communication ($P=0.15$) and Commonality ($P=0.5$).

Hypothesis 5: Males and females should become respectively more ‘male-like’ or ‘female-like’ with age, as their sexual identity become more prominent.

We tested whether characteristics deemed ‘male-like’ (Table 1) or ‘female-like’ (Table 2) increased with age. First, we found no statistical correlation between ‘male-like’ variables and male age (Table 1).

Figure 4
Table 2: Correlations between female age and ‘female-like’ variables.

Variables	<i>r</i>	<i>P</i>
Collectives	-0.035	0.56
Communication	0.013	0.82
Human Interest	-0.08	0.20
Commonality	0.147	0.02

As for girls, Commonality is the only ‘female-like’ variable whose values increase with age (Table 2). Finally, we found no correlations between ‘male-like’ characteristics and female age, or between ‘female-like’ characters and male age.

{image:4}

DISCUSSION

Using computer-mediated communication and online journals, our aim was to illuminate to what degree language usage changes with age and differ between the sexes during adolescence. Overall, our main finding was that language use among online journal authors seems to change less than predicted by current hypothesis.

COMPLEXITY

Nippold and Taylor^[26] argued that vocabulary, grammatical operations and idiomatic phrases are expected to increase through adolescence, indicating an increased complexity of language usage. Our results, which did not reveal any significant increase in complexity through adolescence, can be explained by a number of factors. The Complexity variable cannot be easily defined, and even our proposed definition (which takes embellishment into account) may not be satisfactory. This problem may be solved by taking into account other variables such as variety of word use, grammatical complexity and average sentence length, which unfortunately cannot be obtained through DICTION. Another explanation was proposed by Rodino^[36] who argued that internet language may be oversimplified and therefore exhibit less variation with age and sex than spoken language. It would be important to compare our results with quantitative analyses based on spoken language data.

CONFIDENCE, AGGRESSION AND COOPERATION

Previous studies by Eckert and McConnell-Ginet^[37] had shown that women tend to use language that is more passive and lower in self-confidence than men, who tend to be more aggressive and less concerned with politeness^[38]. Bogin and Locke^[20] have explained those finding by arguing that confidence levels should be higher in men so as to enable better performance in activities such as verbal duelling and courtship. Our results showed that increases in Certainty scores correlate with age only in males, with a significant increase over the six year span. The absence of a trend in females may be explained by a possible increase in Certainty before the age interval covered by our study, i.e. before age 12-13 years. This hypothesis could be tested by future studies on pre-adolescent females.

SEXUAL DIFFERENCES

We hypothesised that several gender differences in variables reflecting language use would develop during adolescence. This expectation was based upon previous studies indicating that males were more likely to show interest in displaying putative qualities and to describe events of action, location and timing, while females would be more liable to discuss personal affairs and relationships^[17]. We also hypothesised that both traits deemed to be more ‘male-like’ and ‘female-like’ would increase with age, as sexual differences would tend to become more pronounced. Although not all of the hypothesised sexual differences occurred, our results confirmed the predicted differences between males and females in their expression of Numerical Terms, Accomplishment (where males scored higher than females), Human Interest (where females scored higher than males) and Spatial Awareness (where females scored higher than males, contrary to our expectations). Some of these results, in particular the large difference between males and females with regards to the Human Interest variable, support the previously held assumption that females tend to discuss and reinforce relationships with other members of their social group, whereas males tend to be more interested in the physical world and the attainment of status through boasting of achievement rather than ‘political back-biting.’

It should be noticed that Aggression scores were not as polarised as expected. A possible explanation might be that although adolescent males are more likely to partake in intra-group physical violence than females, this may not be directly expressed in verbal sphere^[17]. Relational aggression^[39], in which competitors are ridiculed through

shun or gossiping may in fact be higher in females, where the need to make other females seem unattractive^[40] or disrupt other female coalitions^[41] may be seen as essential.

Although we predicted that females would demonstrate a greater emphasis on shared values^[38], social dynamics might also explain why we found no significant difference in Commonality scores. However, although female Commonality scores do increase with age, there was no significant difference between the sexes. This may be because males often focus their aggression on outgroups of males and may often emphasise their own social group values^[42].

Other variables for which there was no significant difference included Motion, Temporal Awareness, Collectives, Embellishment and Activity. The absence of significant differences in 11 of the 16 studied variables suggests that blogs created by adolescents of different sexes are more alike than different, a finding that corroborates the findings of Huffaker and Calvert^[35].

CONCLUSIONS

Human language provides exciting challenges for anthropologists. Computer mediated communication, in particular online journals and blogs are useful as they allow individuals to freely express ideals, experiences and feelings. Although they are widely accessible, easy to navigate and rich in data, caution must be taken. Since data are entered by users, their age and sex cannot be verified. It is also apparent that the findings of one type of computer-mediated communication cannot be necessarily generalised to other contexts^[43]. However, the relatively large sample size used in our analyses may partially minimise those problems. Future progress should involve further development of software and quantitative techniques, allowing for more sophisticated analyses of language.

As well as highlighting how computer-mediated communication can be utilised for the study of language evolution, we also attempted to analyse the role of life history (in particular adolescence) and sexual selection in the origin of language differences between the sexes. Although the study did not yield significant data regarding the complexity of written language development through adolescence, the effect of age on some measures of sexual dimorphism in language usage suggests that adolescence may play a role in pragmatics and performative aspects. However, changes as a function of increasing age during adolescence were much less pronounced than we predicted.

Our results showed that a significant fraction of sexual dimorphism in language was already present before the onset of adolescence, contradicting the hypothesis recently proposed by Bogin and Locke that the evolution of an extended human adolescence was the consequence of the role of adolescence in the development of sexual dimorphism in language. In summary, the relation between life history and language evolution in humans is still open to debate.

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