THE DEVELOPMENT OF MORPHOSYNTACTIC COMPLEXITY IN EMIRATI ARABIC

EMALAC Project Research Team

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Measuring Grammatical Development

- phonological development: measured as number of segments (e.g. pMLU)
- morphosyntactic development: measured as increase in the length of the child's utterances in terms of morphemes or words
- lexical development: measured as an increase in lexical diversity (e.g. type/token ration (TTR) or statistically extracted corpus samples (VOCD)

Measuring Grammatical Development

- syntactic development: measured by evaluating the growth of "complexity" in the syntactic structures that the child uses (e.g. Index of Productive Syntax (IPSyn))
- pragmatic and discourse development: measured by indices that take into account the use of referential expressions and the relation between number of utterances and turns that the child takes in a conversation

Mean Length of Utterance index (MLU)

- number of words per utterance (MLU_w)
- number of morphemes per utterance (MLU_m)

- Calculating MLU involves two stages:
  - Identifying 100 consecutive independent utterances for all the children, and
  - Identifying the number of words or morphemes in each of these utterances.

Mean Length of Utterance index (MLU)

- One of the most widely used measures of morphosyntactic development, since Brown (1973)
- In normal children and as a diagnostic of language impairment (Eisenberg et al., 2001)
- MLU_m's correlation with age for a given population is significant (Miller and Chapman, 1981).

Mean Length of Utterance index (MLU)

- the validity of MLU_m has been challenged:
  - ad-hoc decisions involved in utterance segmentation (c.f. Crystal 1970)
  - difficulty in calculating MLU_m in languages with complex morphological systems (e.g. Thordardottir & Weismer, 1998, for Icelandic).

Arabic MLU

- We test the validity of MLUm in a longitudinal study of Emirati Arabic L1 acquisition
- First systematic attempt to perform a series of validity tests of this type in an Arabic dialect
- Some work in related languages (e.g. Dromi & Berman 1982 for Hebrew)
- MLUm used without discussion in some Arabic studies of normal and impaired children (e.g. . Shaalan & Khater 2006)

EMALAC

- Two-year project to develop an Emirati Arabic Language Acquisition Corpus (EMALAC) funded by the United Arab Emirates University Research Affairs
- Transcriptions of 41 30-minute videos of conversations between six Emirati children.
- We limit our calculations to three children due to gaps in the recording.

EMALAC

Abdulaziz		Mohammed		Fatima	
Age	NoU	Age	NoU	Age	NoU
43	468	45	187	47	248
44	193	46	180	49	53
45	186	47	227	50	196
46	430	48	140	52	179
47	352	49	318	53	217
48	170	50	328	55	143
49	137	51	287	56	80
51	216	53	81	57	283
52	124	54	356	59	322
55	297	55	482	60	169
56	192	58	189	61	345
57	71	59	297	62	331
58	134	60	95	63	184
59	198	61	403	64	242
60	250	62	228		
total	**3418**		**3798**	**2992**	

Age in months

NoU = Number of Utterances

MLUm Calculation

- Utterance segmentation based on standard procedures adopted from work in other languages and Brown's (1973) rules.
- Utterances excluded:
  - partial utterances, interrupted by speech or some other external event
  - unintelligible utterances that contain segments that are not recognized
  - full repetitions of the preceding utterance
  - rote passages such as nursery rhymes and songs.

MLUm Calculation

- After these exclusions the first 100 intelligible child utterances from each transcript were examined for number of morphemes.
- The calculation was based on a number of rules, based partially on Dromi and Breman (1982) for Hebrew and adapting the rules to Arabic to accommodate idiosyncrasies of Emirati Arabic morphology.
- The choice between accepting a specific string as mono- or poly-morphemic was mainly based on productivity checks.

Results

Abdulaziz

Age	MLUm
43	4.43
44	4.30
45	5.22
46	4.60
47	4.43
48	4.55
49	5.89
51	4.78
52	5.97
55	5.14
56	5.51
57	5.46
58	4.43
59	4.30

Mohammed

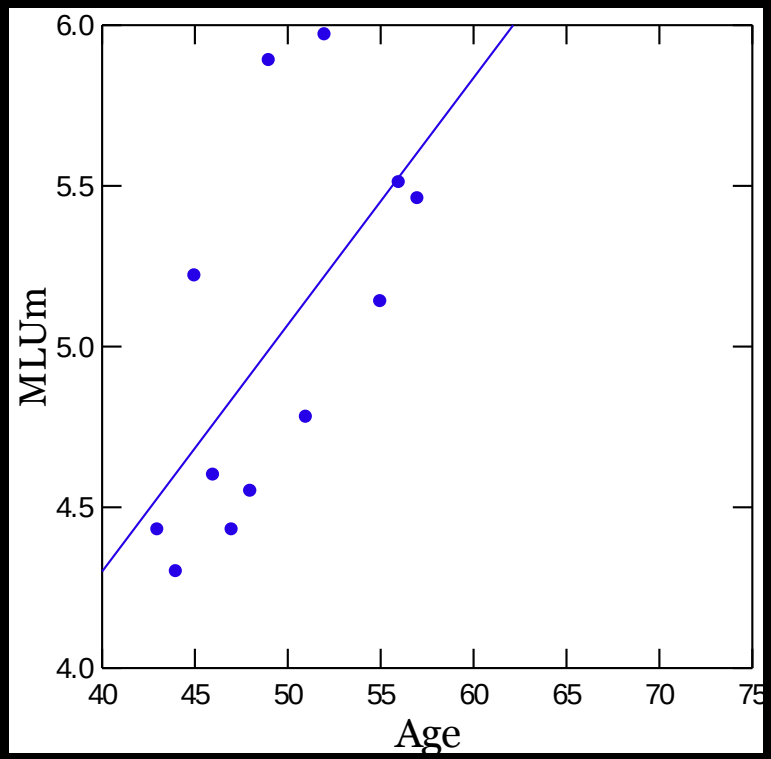
Age	MLUm
45	5.00
46	3.62
47	4.24
48	3.59
49	4.93
50	4.43
51	4.59
53	3.86
54	4.46
55	4.49
58	3.67
59	4.96
60	7.08
61	5.00

Fatima

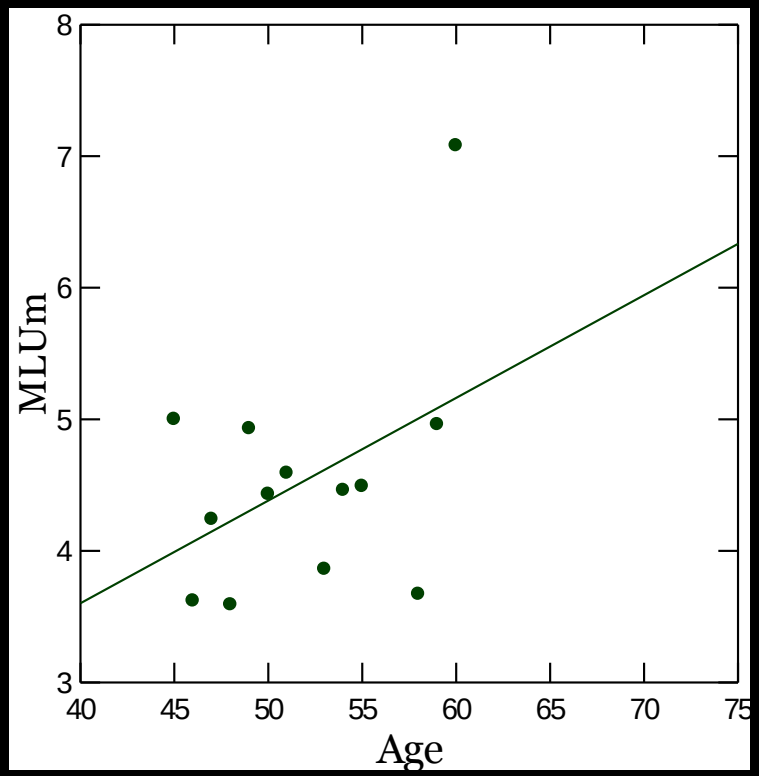
Age	MLUm
47	3.44
49	2.43
50	3.29
52	3.81
53	3.89
55	2.85
56	2.54
57	4.15
59	3.79
60	3.87
61	4.62
62	4.08
63	3.44
64	2.43

Results

Abdulaziz

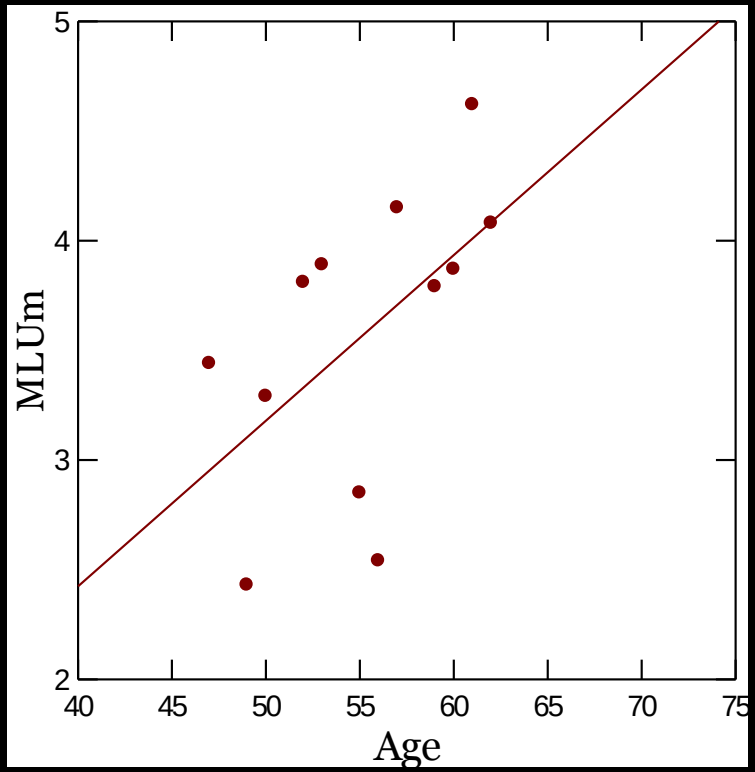


Mohammed



Results

Fatima



Results

- Pearson correlation coefficients (age/MLUm):
  - Abdulaziz 0.623 ($p<0.025$)
  - Mohammed 0.428 ($p<0.1$)
  - Fatima 0.555 ($p<0.025$)
- Significant positive correlation between the two variables.

Results

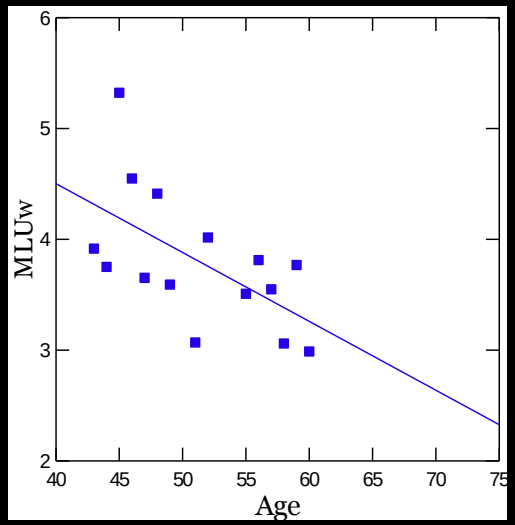
- There is an average increase of 0.22 morphemes for every three months for the three children
- Thus, a year-period corresponds to roughly increasing MLUm by one morpheme per utterance
- Compatible with results in studies for other languages. Klee et al (1989) found that the MLUm of their sample of normally developing children increased by an average of 0.085 morphemes a month (1.02 morphemes per year).
- Conclusion: MLUm is a reliable index of morphosyntactic development in Emirati Arabic, as it correlates with age and exhibits a stable increase as the child becomes older.

Other Measures: Mean Length of Utterance in words (MLUw)

Abdulaziz		Mohammed		Fatima	
Age	MLUw	Age	MLUw	Age	MLUw
43	3.916	45	5.229	47	2.557
44	3.751	46	3.094	49	2.057
45	5.322	47	3.810	50	2.178
46	4.549	48	2.486	52	2.508
47	3.652	49	3.477	53	2.041
48	4.412	50	3.250	55	2.176
49	3.591	51	3.121	56	2.304
51	3.069	53	2.333	57	2.881
52	4.016	54	2.834	59	3.599
55	3.508	55	3.143	60	2.952
56	3.813	58	2.693	61	3.452
57	3.549	59	2.861	62	2.830
58	3.060	60	4.516	63	2.696
59	3.768	61	3.265	64	2.917

MLUw

Abdulaziz



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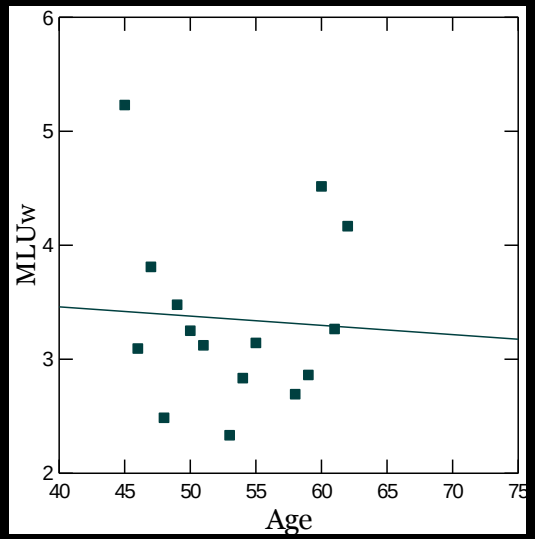
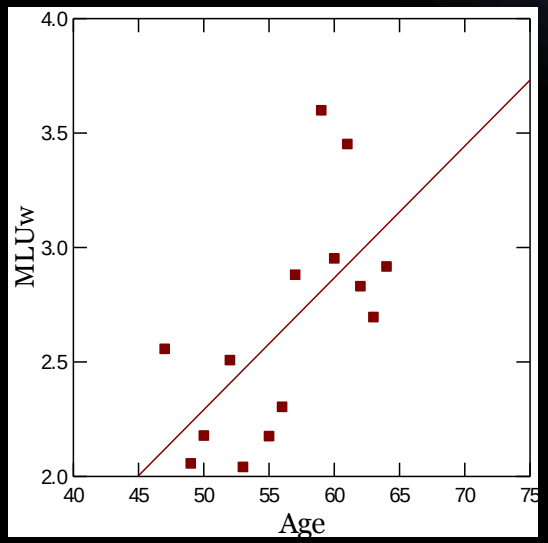


Fatima



MLUw

- The only significant correlation between age and MLUw was found for Fatima (Pearson correlation efficient of 0.645, $p<0.025$)
- Abdulaziz and Mohammed showed surprisingly a negative correlation.
- Not sure why our results are different from those obtained in other languages (e.g. Parker & Brorson 2005).
  - Fundamental difference in the morphological make up of Arabic and languages of the Indo-European family.
  - A small number of words may still correspond to extremely complex morphologically utterances
  - more data is needed to establish with precision the exact correlations between the different indices of morphosyntactic development.

Type-Token Ration (TTR) and VOCD

- Type-Token Ratio (TTR): the ratio of different words (Types) to the total number of words (Tokens)
- Vocd: analysis of the probability of new lexical items introduced into increasingly larger transcript samples.
- By comparing this model with the transcript, *vocd* provides a new measure of vocabulary diversity that is referred to as D.
- **D** is an indicator of the aggregate probabilities of word occurrences in a text and is independent of the size of the transcript.

TTR and D Results

Abdulaziz			Mohammed			Fatima		
Age	D	TTR	Age	D	TTR	Age	D	TTR
43	185.699	0.551	45	173.210	0.590	47	109.400	0.616
44	127.140	0.493	46	127.250	0.544	49	93.500	0.697
45	151.664	0.576	47	147.660	0.570	50	152.190	0.721
46	169.509	0.509	48	180.060	0.625	52	178.580	0.575
47	196.160	0.530	49	165.294	0.545	53	170.815	0.710
48	142.819	0.520	50	192.360	0.590	55	158.509	0.634
49	177.610	0.596	51	218.705	0.614	56	172.780	0.670
51	224.729	0.546	53	104.170	0.658	57	170.104	0.633
52	159.940	0.569	54	199.164	0.619	59	162.805	0.536
55	248.090	0.633	55	293.600	0.598	60	143.590	0.738
56	191.680	0.576	58	128.880	0.550	61	151.259	0.503
57	111.000	0.639	59	202.880	0.635	62	158.599	0.588
58	222.680	0.529	60	181.130	0.619	63	110.140	0.564
59	152.410	0.494	61	174.400	0.568	64	102.819	0.447

TTR and D Results

- No significant positive correlation between age and TTR or D. Why?
- Size of file plays a role in the calculation of TTR
  - (for example, Fatima's TTR at age 64 is 0.447 with a total of 667 tokens, while at age 56 her TTR value jumps to 0.670 with a file size of just 182 tokens)
- File size should not play a role in VOCD calculations

TTR and D Results

- The problem probably lies in the transcription conventions that are followed in the EMALAC database. All transcription is in IPA
- same types of words are transcribed with minor differences if the children pronounced them differently in different contexts
- children often omit unstressed syllables or simplify consonant clusters, shorten long vowels, and so on

Abdulaziz (43 months):	[ma:]	(32 tokens
	[la:]	(6 tokens)
	[ma]	(2 tokens)
	[la]	(3 tokens).

- The vocd command on the CLAN program will list these as four different types.

TTR and D Results

- In the early stages when children adjust the target vocabulary to their phonological capabilities, more types are listed and thus the type-token ratio is artificially increased.
- In later stages, when children have mastered the target phonology, less types are listed and the D values are closer to reality.
- This results in a distorted view of lexical diversity in the children's transcripts.

Utterances over Turn (UoT)

- The number of utterances the children produced in each turn.
- This index measures the number of complete ideas expressed by the child during each turn taken
- It is predicted that as the children grow older they should exhibit longer conversational turns (i.e. they should hold the floor for a longer period of time during conversation).

Utterances over Turn (UoT)

Abdulaziz		**Mohammed**		**Fatima**	
Age	UoT	Age	UoT	Age	UoT
43	1.020	45	1.030	47	1.032
44	1.237	46	1.139	49	1.082
45	1.021	47	1.007	50	1.022
46	1.004	48	1.129	52	1.029
47	1.290	49	1.142	53	1.021
48	1.030	50	1.012	55	1.144
49	1.269	51	1.129	56	1.013
51	1.430	53	1.095	57	1.097
52	1.159	54	1.059	59	1.233
55	1.208	55	1.323	6	1.299
56	1.362	58	1.132	61	1.234
57	1.224	59	1.173	62	1.250
58	1.426	60	1.667	63	1.252
59	1.584	61	1.393	64	1.337

Utterances over Turn (UoT)

- very strong positive correlation between age and UoT ration.
  - Pearson correlation coefficient values:
    - Abdulaziz 0.694 (n=14, p<0.005)
    - Mohammed 0.738 (n=14, p<0.005)
    - Fatima 0.863 (n=14, p<0.001)

- strong correlation between MLUm and UoT for two out of the three children in the study.
    - Abdulaziz 0.226 (n=14, p>0.1)
    - Mohammed 0.734 (n=14, p<0.005)
    - Fatima 0.475 (n=14, p<0.05)

- morphological complexity and conversational strength seem to grow in parallel for the children under investigation.

Discussion

- The data sections clearly indicate that some of the developmental measures used are more successful than others.
- The significant result is the strong correlation between age and MLUm.
- This indicates that MLUm is a reliable index for measuring morphosyntactic development.
- The significance of this result is very important because it allows us to accurately:
  - place a child in a specific developmental period
  - compare children within the same linguistic environment
  - compare a child to itself developmentally

Discussion

- As far as cross-linguistic comparison is concerned, the range of MLUs that we got for the children is:

	MLUM	PREDICTED-AGE[1]	ACTUAL-AGE
Fatima:	2.43-4.62	31.6-47.3	47-64
Abdulaziz:	4.30-5.97	45-68.3	43-59
Mohammed:	3.59-5.00	39.5-50.5	45-61

1 Age predicted for English children based on this MLU range in Brown (1973)

Discussion

- Abdulaziz and Mohammed: MLUm range is comparable with the values for English children
- Fatima: the MLUm values predict a much lower age range than her actual age.
- It may be that Fatima's language has not developed as quickly as with the male subjects (although we do not have enough data at this point to make any claims about gender differences in morphosyntactic development).
- The initial results are encouraging in that they seem to accurately place the children in the right age-ranges.
- A more accurate picture should emerge when more data is introduced from a greater number of children and when Brown's stages are adapted to the linguistic reality of Emirati Arabic.

Conclusion

- We tested the validity of MLUm in EA based on conversations of three Emirati children over a period of 18 months.
- We found a positive correlation between MLUm and age for all three children.
- Additionally, we calculated indices of lexical development (VOCD, TTR), mean length of utterance in words (MLUw), and utterances over turn (UoT).
- While UoT numbers showed positive correlation with age and MLUm, MLUw and VOCD numbers were not stable.
- We attributed this to the idiosyncratic morphology of Emirati Arabic and to our choice of transcription conventions which misrepresent the type-token ratio of the transcribed files.

Thank you!