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The Malta Journal of Health Sciences is a peer-reviewed, open access publication that promotes the sharing and exchange of knowledge in Health Sciences. It provides a platform for novice and established researchers to share their findings, insights and views within an inter-professional context. The Journal originates within the Faculty of Health Sciences, University of Malta.

The Malta Journal of Health Sciences disseminates research on a broad range of allied health disciplines. It publishes original research papers, review articles, short communications, commentaries, letters to the editor and book reviews. The readership of the journal consists of academics, practitioners and trainee health professionals across the disciplines of Applied Biomedical Science, Audiology, Communication Therapy, Community Nursing, Environmental Health, Food Science, Health Services Management, Medical Physics, Mental Health, Midwifery, Nursing, Occupational Therapy, Physiotherapy, Podiatry and Radiography.

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Guest editorial

THE FACULTY OF HEALTH SCIENCES: LOOKING AHEAD

Roberta Sammut

Dean, Faculty of Health Sciences, University of Malta, Msida, Malta

The last Editorial by Professor Angela A. Xuereb Anastasi, in Volume 4, Issue 1 of this journal, provided a summary of the achievement the Faculty of Health Sciences has obtained over the past seven years. As Professor Xuereb Anastasi moves on to her well-earned sabbatical, I thank her on behalf all members of staff for the achievements of the Faculty under her leadership over these years.

As I now take up the baton from her as Dean of the Faculty of Health Sciences, I know that I have stable ground to work on, and I look to the future with optimism and enthusiasm to continue to see the Faculty grow and mature.

Where do I envision the Faculty will go over the next four years?

Firstly, I would like to see greater collaboration between the Departments within the Faculty and greater openness of the Faculty to work with other Faculties, both teaching and research. This should provide the possibility of new ideas being created, bringing a breath of fresh air, which is not possible if we maintain a 'silo' mentality.

To achieve this, we must communicate better with each other, with other Faculties and with society at large. Amongst other possible ways to achieve this, is the effective use of social media. The Faculty has already established a Facebook and Twitter page, which we invite you to follow, where we can share what is going on inside our walls with other

staff members within the University, practitioners, many of whom are our alumni, and the general public. Secondly, I see a Faculty where the voice of every stakeholder is heard, that is the academics, the administrators, the students and the persons who we serve and care for.

The educational and health care context within which we are used to working is changing. Other higher education entities are offering programmes of studies which parallel those offered by the Faculty of Health Sciences. Local health care entities are increasingly being privatised. These observations suggest that the Faculty needs to adapt in response to these changes if it is to retain its position of excellence as the primary education provider for health care professionals on the island. To do this we must ensure that the programmes offered are sustainable over the years and that we have the tools and methods to ensure that sustainability.

Above all, my vision for the Faculty is that it provides a voice within society, guiding the development of health care policy to assure that the services provided are based on the latest available evidence, obtained through a strong research framework. This should ensure the value of the Faculty of Health Sciences for Maltese society. The years ahead are very promising and exciting, and I am sure my colleagues are as excited as I am. I hope that over these four years, the Faculty will continue to grow in its value for our country.

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Research Paper

INVESTIGATING WORD BLENDING SKILLS IN MALTESE CHILDREN

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Abstract. This study aimed to investigate the word blending skills of six to seven year old Maltese children whose home language is either Maltese/English (monolinguals) or Maltese-English (bilinguals). Typically developing children and children with reading difficulties from different school systems (State, Church, Private) were selected. Parents were asked to complete a language and literacy questionnaire prior to test administration. The participants' word blending skills were assessed in English using the 'Blending Words' subtest of the 2nd edition of the Comprehensive Test of Phonological Processing. They were also tested in Maltese using a word blending test developed for the purpose of this research. The main findings show overall better performance in Maltese word blending tasks. Girls performed better than boys and State school performance was the highest for Maltese, while Private school performance was superior in English. Results also showed that bilinguals outperformed monolinguals in both language versions of the test. Typically developing children achieved higher scores in word blending than children with reading difficulties and children who were reported to have difficulties with learning the alphabet gave a significantly lower performance. Lastly, questionnaire findings show that frequent reading, reading enjoyment and good alphabet knowledge all result in better word blending abilities. Recommendations include encouraging children to read more frequently in both languages in order to enhance phonological awareness abilities.

Keywords: word blending, phonological awareness, bilingual, Maltese

1 Introduction

1.1 Literacy

Literacy skills are essential to the academic and personal success of those who live in a literate society (Daniel & Reynolds, 2007). Literacy skills include phonological

awareness skills, written language awareness (alphabet knowledge and print concepts), literate features of oral language, memory, speed of processing and comprehension (Justice & Purcell, 2003). The aim of this research was to test the word blending performance, a subset of phonological awareness, of Maltese children aged 6-7 years.

In this bilingual community, children are faced with learning literacy in both Maltese and English. These two languages have orthographies of differing depth. Orthographic depth, the degree of spelling-to-sound consistency in each language, has been hypothesized to affect the ease and effectiveness with which children learn to read (Everatt & Ocampo, 2001; Frost, Katz, & Bentin, 1987). Whilst English is said to be a 'deep' or 'opaque' language, Maltese is more transparent in terms of its phoneme-grapheme correspondences (Agius, 2012; Xuereb, 2009). Katz and Frost (1992) explain that in shallow orthographies (like Maltese), phonology is more readily available whilst in opaque orthographies like English; the child has to recognize words through morphology.

1.2 Alphabet Knowledge

Emergent literacy skills include alphabet knowledge which is the ability to name letters, distinguish letter shapes, and identify letter sounds. A child needs to recognise letters, understand that they have corresponding sounds and blend the sounds together to form a word for reading and writing (Drouin, Horner & Sondergeld, 2012) in order to access print. Learning that there are predictable relationships between sounds and letters allows children to apply these relationships to both familiar and unfamiliar words and to begin to read with fluency. Alphabet knowledge is important for children, because it introduces them to the issue of orthographic knowledge, which in turn, is essential for spelling (Phillips, Piasta, Anthony, Lonigan & Francis, 2012; Puranik, Petscher & Lonigan, 2012). Children's knowledge of letter names and shapes is a strong predictor of their success in learning to read. Knowing letter names is strongly related to children's ability to remember the forms of written words and their ability to treat words as sequences of letters. The relationship between alphabet knowledge and future reading ability are positively linked to each other (Moats, 2014), so much so, that a child's inability to recognize the alphabet may result in later reading problems (Phillips et al., 2012).

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1.3 What is phonological awareness (PA) and word blending (WB)?

Phonological awareness (PA) is the area of oral language that relates to the ability to think about the sounds in a word (the word's phonological structure) rather than just the meaning of the word (semantics). It is an understanding of the structure of spoken language – that it is made up of words and words consist of syllables, rhymes, and sounds (Konza, 2011). Longitudinal studies of reading development show that PA is a main predictor of success when learning to read English and a significant constituent of spelling skills (Fawcett, 2013; McGeown & Medford, 2014; McGeown, Johnston & Medford, 2012; Tahan, Cline & Messaoud-Galusi, 2011; Elbeheri & Everatt, 2007; Weinrich & Fay, 2007; Celek, Pershey & Fox, 2002). In the case of the Maltese language, speed of processing and phonological memory are better predictors of reading ability than phonological awareness. This is because of the difference in orthographic depth between the two languages (Agius, 2012; Xuereb, 2009). PA lets children understand how language can be separated into smaller parts and how these parts can be manipulated (Daniel & Reynolds, 2007). When blending a word, the child is required to listen to a sequence of sounds and combine these together to make up a word e.g. /c/-/a/-/t/ to make the word /cat/ (Fawcett, 2013). The words are heard in small parts (or individual sounds) and the person blending these parts joins them together, forming the word (Weinrich & Fay, 2007). The skills needed for word blending include letter-sound knowledge, memory (auditory if sounds are being heard, visual if sounds are being read) and phonological awareness. There is also an element of automaticity involved.

1.4 The ability to blend a word also allows the reader to access print

Accessing print entails converting graphemes to phonemes and then blending these (decoding) – allowing children to read (Iacono & Cupples, 2004). In order to decode, the child needs to have adequate comprehension skills, the ability to recognise each letter and each sound as well as blend (Drouin, Horner & Sondergeld, 2012; Turnbull, Bowles, Skibbe, Justice & Wiggins, 2010).

In this research, the English word blending test (CTOPP-2, Wagner, Torgesen, Rashotte & Pearson, 2013) was used and a Maltese test was developed by the researcher for the purpose of research following specific guidelines (Agius, 2012). The

Maltese words selected were analysed so as to parallel the English test. Both tests comprised 33 items and the Maltese items were written according to the International Phonetic Alphabet (IPA) to eliminate any discrepancies in pronunciation (See Table 1 for examples of test items).

1.5 Gender and phonological awareness (PA)

The literature reports a higher incidence of males with reading problems. Hawke, Olson, Willcut, Wadsworth and DeFries (2009) investigated reading recognition, reading comprehension and spelling and found that “*the greater variance of their composite measure of reading performance for males is due to gender differences in phenotypic variances and covariances of the tests*” (p.3). Local research on gender difference and PA is ambivalent. Mifsud, Grech, Hutchison, Morrison, Rudd and Hanson, (2004) conclude that girls perform significantly better than boys in PA activities in both Maltese and English. Cilia (2010) found that boys were faster and more accurate than girls when reading. A more recent study on PA skills in Maltese children found no significant difference between the two genders (Formosa, 2014).

1.6 School system and language used in relation to phonological awareness (PA)

Local research has shown that the interrelation between school language and school type has an effect upon literacy performance (Agius, 2012; c.f. Cilia, 2010). Mifsud et al., (2004) note that children attending Church and Private schools achieve significantly higher scores in PA skills in English than children attending State schools. With regard to ability, significant differences are noted between typically developing (TD) children and children with reading difficulties (RD) where TD children performed better. Results showed that literacy skills in one language can be anticipated by “*parallel reading and writing skills in the other language*” (Agius, 2012).

Rosal, Cordeiro and Queiroga (2013) investigate phonological awareness in children from public and private schools in Brazil where the performance of both groups was compared. The analysis revealed no statistically significant differences in PA skills between schools and inferred that a specific school system did not assure a better PA development for children.

Table 1. Examples of English and Maltese Test Items

Test Item Number	English Test Item	Maltese Test Item	Maltese Test Item in IPA	Number of syllables
2.	Sea-shell	Maġenb	mɛ-ʤɛnp	2
9.	S-un	Ġiet	ʤ-i:t	1
14.	T-oy	Bir	b-ir	1
23.	G-r-a-ss-h-o-pp-cr	Laringa	l-ɐ-r-i-n-ʤ-ɐ	3
29.	M-ath-c-m-a-t-i-c-s	Ġenituri	ʤ-ɛ-n-i-t-u-r-i	4

1.7 Language dominance and phonological awareness (PA)

According to Formosa (2014), Agius (2012) and Mifsud and colleagues (2004), children perform best when tests were presented in their first (or home) language. Agius (2012) also found that bilingual children outperformed monolingual children in tests of phonological awareness and literacy. Xuereb (2009) examined the reading and PA skills in 8 – 10 year old Maltese-speaking children and found that reading performance was better in Maltese than in English. According to Xuereb (2009), this finding can be explained by the fact that the tests were presented in the same language as their home language, or to the fact that the Maltese test items (the language with the more regular orthography) were easier to access (and decode) than the parallel English test items.

Overseas research has reported inconsistent findings. Reyes and Azuara (2008) studied the association between language dominance and literacy skills in Mexican immigrant children who spoke Spanish and English. Like local research, they too found that biliteracy skills are dependent upon the children's home language. Gutierrez-Clellen and Kreiter (2003) and Tahan, Cline and Messaoud-Galusi, (2011) however did not find a significant association between PA and the child's first language.

1.8 Reading interest, frequency and literacy environment

Logan and Johnston (2009) state that the attitude the child has towards reading, has an impact on the frequency of reading and reading ability itself. Reading (dis)ability may be affected by length of words, frequency of words and the age-of-acquisition of certain words (Davies, Cuetos & Glez-Seijas, 2007). Children who are interested and engaged during literacy activities are likely to have more opportunities to learn and practice early reading skills (Baroody & Diamond, 2014). The home environment also affects children's reading abilities. Manolitsis, Georgiou and Tziraki (2013) found that when children are exposed to more literacy activities in the home, they show increased reading performance. Consequently, when a child shows an interest in literacy activities, parents and teachers are more ready to provide such activities (Martini & Senechal, 2012).

1.9 Importance of this study

This study is important because in Malta there is limited research on reading and phonological awareness and how these abilities function within a bilingual environment. Findings would also shed light on reading abilities, specifically word blending skills, in the context of differing school types, gender, ability, home and school language of children with varying ability. This information is useful to professionals, educators and researchers alike.

2 Methods

Ethical approval for this research study was obtained from the University of Malta Research Ethics Committee (approval reference number 107/2014). All relevant permissions and consent to carry out the research study were processed. Codes were generated and used throughout the study to ensure anonymity of participants. The research question begged a quantitative research design, involving the collection of data for analyses through statistical inferences (McLeod, 2008).

2.1 Participant selection

Schools were randomly selected and permission was obtained from heads of school to carry out the research study. Thirty (30) children from a State school, 33 from two Church schools, and 37 from a Private school participated in the study (total – 100 children). Two different Church schools were selected because these are not coeducational and both males and females in each school system were required. A meeting took place with the year 2 class teachers of the classes participating in the study. The aim of the study as well as the selection criteria were explained carefully so that the teachers could make an informed decision when selecting children to participate in the study. The participants selected (6-7 years old) attended year 2.

Typically developing participants had to be Maltese citizens, aged between 6 and 7 years, attending year 2, their first language Maltese and/or English, have a satisfactory school performance, with no sensory, behavioural or emotional difficulties and no positive family history of reading and/or spelling difficulties. Satisfactory school performance was gauged by the teacher and based on the child's academic progress throughout the scholastic year. This might be considered as a limitation as no standardized assessment was used to test the children's ability e.g. Ravens Coloured Progressive Matrices and neither was a reading test.

The same selection criteria were applied to children with reading difficulties. However, these children were not expected to have satisfactory school performance. They were included in the study with a report of average or poor school performance, with possible behavioural or emotional difficulties and a possible positive family history of reading difficulties. Meetings were scheduled with the principals of each school to explain the purpose of the study and what it would entail. Once the children were selected, a second meeting was scheduled, in which the teachers were provided with a letter of information, parental consent form and questionnaire to be sent home.

2.2 Research tools and administration

The 'Blending Words' subtest of the 2nd edition of Comprehensive Test of Phonological Processing (CTOPP-2; Wagner, Torgesen, Rashotte & Pearson, 2013) was used to assess blending skills in English. Permission was obtained to use the 2nd edition of Comprehensive Test of Phonological

Processing (CTOPP-2) (Wagner, Torgesen, Rashotte & Pearson, 2013). The word blending subtest was used. This is a 33-item subtest measuring an individual's ability to combine sounds to form words. The examinee listens to a series of separate sounds and then is asked to put the separate sounds together to make a whole word.

A Maltese-equivalent test was compiled by choosing words from the children's reading books used in the three school systems. The selected words were analysed according to word characteristics such as frequency, imageability and concreteness. The words chosen varied in high/low frequency, high/low imageability and high/low concreteness and were chosen to parallel the English test. The criteria used to select the Maltese test items were based on those by Xuereb, Grech and Dodd (2011). Following pilot data collection, it was noted that the test lasted approximately three to eleven minutes.

One Hundred (100) children were tested on English and Maltese word blending in the main study. Assessments were carried out in a classroom or common room and administered by the researcher to each child individually. To avoid the possibility of practice and order effects the researcher alternated between starting with the English test and the Maltese test. The tests were also timed by using a digital stopwatch to calculate the duration of administration of the tests.

A language and literacy questionnaire was developed for the purpose of this research project and given to the participants' parents. The questionnaire consisted of 10 questions which addressed: the home language spoken by the child's family members, the language the child uses at school, whether or not the child enjoys to read and if so, how often s/he reads and in which language s/he prefers to read. The questionnaire also asked about the possible presence of family history of reading difficulties, the method in which s/he was taught to read (e.g. via the phonics approach) and if s/he had previous difficulties in learning the alphabet. The questionnaire was distributed and collected through the school with the help of class teachers.

2.3 Data analysis

The scores of each test were converted to percentage correct (%) scores for comparative purposes. These were analysed using the Statistical Package for the Social Sciences (SPSS) version 22.0 software package. Information regarding the gender, school system, home language, school language and ability (independent variables) and the questionnaire responses were also inputted into SPSS. Descriptive statistics were obtained for the test scores and analysis of variance (ANOVA) was used together with the non-parametric test Kruskal-Wallis to develop a statistical measure to compare between the variables. The nonparametric test was used following tests of normality which indicated that the distribution of both the Maltese and English test data were skewed.

3 Results

3.1 Normality testing

The Shapiro-Wilk's test (Table 2) was used to assess the normality assumption of the score distribution for Maltese and English word blending tests as well as the total time taken to complete both tests.

Table 2. Shapiro-Wilk's test of normality

	Shapiro-Wilk		
	Statistic	df	p-value
Maltese word blending	0.953	100	0.001
English word blending	0.968	100	0.015
Total time taken	0.969	100	0.019

Results showed that the p-values (0.001, 0.015, and 0.019) for both tests and their duration were <0.05 level of significance, thereby indicating a non-normal distribution. For this reason, the nonparametric Kruskal-Wallis H test was used. This is a rank-based nonparametric test that can help determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable (Lund & Lund, 2013). Since this test generates ranks, Analysis of Variance (ANOVA) was also used to compare mean scores.

3.2 Overall findings

Descriptive statistics show that overall: children obtained an average score of 71% in Maltese word blending (MWB) and an average of 67% in English word blending (EWB) (see Table 3).

Table 3. General performance of participants

	Minimum	Maximum	Mean	Standard Deviation
Maltese Word Blending	30	97	71.01	16.49
English Word Blending	39	88	66.61	11.60
Total time taken	234	431	331.28	51.89

3.3 Gender

Findings show that on average girls performed better than boys, however not significantly, in both Maltese (73% mean score) and English (67% mean score) word blending tests (see Table 4). Boys obtained 69% mean score and 65% mean score respectively. There was no significant difference between the two groups for either test (MWB, $p=0.25$; EWB $p=0.38$).

Table 4. Results for word blending according to gender

		Parametric ANOVA					Non-Parametric K-W ⁱ	
		N ⁱⁱ	Mean (%)	SD ⁱⁱⁱ	df ^{iv}	F ^v	Chi-square	p-value
MWB	Male	42	69	16.81			1.31	0.25
	Female	58	73	16.12				
	Between groups				1	1.51		
	Within groups				98			
EWB	Male	42	65	12.13			0.84	0.38
	Female	58	67	11.24				
	Between groups				1	0.73		
	Within groups				98			
Total time (secs)	Male	42	329	47.81				
	Female	58	333	55.02			0.14	0.82
	Between groups				1	0.10		
	Within groups				98			

ⁱKruskal WallisⁱⁱPopulation sizeⁱⁱⁱStandard deviation^{iv}Degrees of freedom^vF-distribution**Table 5.** Results for word blending according to school system

		Parametric ANOVA					Non-Parametric K-W ⁱ	
		N ⁱⁱ	Mean (%)	SD ⁱⁱⁱ	df ^{iv}	F ^v	Chi-square	p-value
MWB	Private	37	71	16.14			6.81	.031
	Church	33	68	10.73				
	State	30	74	21.38				
	Between groups				2	1.12		
	Within groups				97			
EWB	Private	37	70	9.47			4.32	0.11
	Church	33	64	9.64				
	State	30	65	15.01				
	Between groups				2	2.21		
	Within groups				97			
Total time (secs)	Private	37	340	41.2			3.21	0.20
	Church	33	331	48.3				
	State	30	321	65.1				
	Between groups				2	1.27		
	Within groups				97			

ⁱKruskal WallisⁱⁱPopulation sizeⁱⁱⁱStandard deviation^{iv}Degrees of freedom^vF-distribution

3.4 School system

Table 5 displays both parametric and nonparametric findings. The nonparametric test results for Maltese word blending are significant ($p=0.03$); its parametric equivalent however is not ($F=1.12$, df 2,97, $p=0.31$). Year 2 children attending

State schools obtained the highest score (74%) in Maltese word blending followed by children attending Private schools (71%). Children from Church schools obtained the lowest average score (68%). In English word blending, children from Private schools obtained the highest score (70%) followed by children attending State schools (65%) and then Church

schools (64%) ($F=2.21$, $df\ 2,97$, $p=0.11$). Findings from both parametric and nonparametric tests were not significant.

3.5 Ability

Typically developing (TD) children achieved higher scores in both Maltese (77%) and English word blending (70%) with a significant difference (MWB $p=0.00$; EWB $p=0.000$) when compared to children with reading difficulties (RD). The RD group obtained 57% in MWB and 58% in EWB.

3.6 Home Language

Children who speak both Maltese and English at home obtained higher scores in both MWB (73%) and in EWB (70%) when compared to monolingual children. The monolingual Maltese group obtained a mean of 71% and the monolingual English speakers obtained a mean score of 68% in *Maltese* word blending. For the English blending task, Maltese monolinguals obtained 64% and English monolingual speakers achieved a score of 67%. In all cases, these differences were not significant (MWB $p=0.37$; EWB, $p=0.14$).

3.7 School language

Children in bilingual classroom environments obtained a higher score in *Maltese* word blending (72%) followed by children who speak mostly English at school (71%) and those who speak mostly Maltese in class (64%). In *English* word blending, children who speak more English in school obtained a score of 68%, followed by children who speak both languages (67%) and children who speak mostly Maltese (59%). These differences between school language were not significant (MWB $p=0.61$; EWB $p=0.21$).

3.8 Questionnaire findings

Questionnaire items were grouped into two main categories: (1) 'reading enjoyment, frequency, language preference' and (2) 'Teaching method and alphabet knowledge'. The test scores were analyzed in relation to these two broad categories.

3.8.1 Reading enjoyment, reading frequency and reading language preference

The children whose parents reported that they enjoy spending time reading at home obtained the highest mean scores in both MWB and EWB. Children who spent more time reading also obtained higher scores in the tests. The children who read less than once a week obtained the lowest mean scores (MWB=48%; EWB=53%). The differences of reading frequency are significant as the p -value < 0.05 criterion in both Maltese (p -value=0.01) and English (p -value=0.1). Children who enjoy reading in both languages obtained highest mean scores in both tests (MWB=78%; EWB=70%).

The difference in scores in English are significant as the p -value is 0.03

3.8.2 Phonics approach and Alphabet knowledge

Children who learnt to read using the phonics approach obtained higher mean scores (MWB=72%; EWB=67%) than the children who learnt to read through another approach (for e.g. sight word approach). Both differences are significant because the p -values are < 0.05 criterion (p -value=0.04, and 0.02 respectively). The children who had difficulties learning the alphabet obtained a lower mean score (MWB=58%; EWB=59%) when compared to those who learnt the alphabet well and with no difficulties (MWB=74%; EWB=68%). Both Maltese and English WB differences are significant, the p -value being 0.00 for Maltese and 0.02 for English.

4 Discussion

The following is an interpretation of the findings in word blending performance of Maltese 6 to 7 year old children. Overall, the children obtained higher scores in the Maltese test. This finding could be explained by the fact that Maltese is 'easier' to read given its transparent orthography and more direct spelling-to-sound correspondences, when compared to English, the more opaque writing system (Agius, 2012; Davies, Cueto & Glez-Seijas, 2007; Seymour, Aro & Erskine, 2003; Xuereb, 2009).

4.1 Gender differences in word blending performance

Although there were no significant differences in word blending between boys and girls, girls obtained higher scores than boys. Most literature agrees that girls tend to give a better performance, and have a more positive attitude to literacy. The current findings are consistent with Cilia (2010) who also did not find significant differences between girls and boys in reading ability. In her study, in fact, boys performed slightly better. In the older group, girls performed better. Gender differences are reported by Mifsud and colleagues (2004), whereby girls performed better in phonological awareness tasks. It is also believed that girls are less affected by environmental aspects e.g. teaching method (Hawke, Olson, Willcutt, Wadsworth & DeFries, 2009; Logan & Johnston, 2009).

4.2 School type and word blending performance

Similar to Cilia's (2010) findings in Maltese word reading, children from State schools obtained the highest score in Maltese word blending. The Maltese language is the favoured language of instruction by most teachers working in State schools and English is the preferred language of instruction in private schools (Agius, 2012; Formosa, 2014).

Agius (2012) also found that superior performance in literacy was obtained when the test language was the same as their first language. This finding (children attending State schools performing better in Maltese, whilst children attending Private schools performing better in English) was replicated in this research. This indicates that school language does in fact play a role in the children's performance on the tests, depending on the language of the tests.

4.3 The effect of home language on word blending

Children who speak Maltese and English at home acquired the highest scores in both Maltese and English blending tasks. Although the difference between bilingual and monolingual speakers was not significant, the indication is that bilingual children process phonological units better than monolingual children as the languages have the same processing system, allowing transfer between languages (Tahan, et al., 2011). Xuereb (2009) found that children speaking Maltese at home performed better in Maltese, when compared to English. Similar findings were reported by Cilia (2010) who noted that performance in Maltese word and non-word reading tasks was associated with the child's first language. Agius (2012) found that bilinguals displayed superior performance in some of the literacy tests administered in her research (writing speed, spelling accuracy, word accuracy and fluency, rapid letter naming) when compared to monolinguals.

4.4 The effect of school language on word blending

Findings (albeit not significant) show that children who speak both languages at school perform better in Maltese word blending. Agius (2012) reports that although Maltese is mainly used in State and Church schools, their use of spoken English is increasing, whilst Private schools continue to use English as the preferred language of instruction. Similar to the current findings, Formosa (2014) also reported that children attending private schools obtained higher scores in English than children exposed to Maltese in the classroom. Agius (2012) observed a '*bilingual enhancement effect*' (which happens when the skills in one language are transferred to the other language) in reading ability and in phonological awareness.

4.5 The effect of ability on word blending performance

In this study, significant differences between TD and RD children were observed on both Maltese and English tasks. This shows that a reading difficulty affects word blending performance, and weak word blending performance may be partly the cause of a reading difficulty. This finding concurs

with those by Agius (2012) and Apel and Lawrence (2011). The latter authors reported that children with speech sound disorders obtained lower scores on blending tasks when compared to typically developing children. Loeb, Gillam, Hoffman, Brandel, and Marquis (2009) found significant correlations between difficulties in PA and reading difficulties (c.f. Suggate et al., 2014). This finding strengthens the abundant literature on the link between phonological awareness and literacy (Daniel & Reynolds, 2007; Everatt & Ocampo, 2001; Frost, Katz, & Bentin, 1987). Remedial programs currently focus their efforts on improving the literacy abilities of RD children through facilitating phonological awareness skills and phonics instruction. These programs can be revised in view of the orthographic depth(s) of the language pair the child is exposed to as well as the importance of other factors (e.g. rapid naming and receptive vocabulary) that are more pertinent to the literacy development of children learning to read transparent orthographies (Xuereb, 2009; Agius, 2012).

4.6 Interpretation of questionnaire findings

4.6.1 Reading enjoyment, frequency and language preference in reading

Baroody and Diamond (2014) conclude that when a child is interested and engaged in literacy activities there would be more opportunities for the child to develop literacy skills, and increase vocabulary. The authors also link together the child's level of enjoyment with frequency. Similarly, this study found that children who enjoyed reading more at home and read more often, tended to perform better in word blending than those who did not. In fact, average scores lessened in line with the frequency with which the children read. When parents and teachers positively reinforce a child, the child will foster a more positive attitude towards reading. Manolitsis, Georgiou and Tziraki (2013) state that the home literacy environment affects children's abilities, depending on whether there is an involvement of literacy activities. It would be beneficial for children to see their family engaging in literacy activities as this would act as an incentive for them to imitate and engage in such activities.

With reference to reading language preference, results showed that children who liked to read in both Maltese and English achieved higher scores in word blending in both languages. By reading in both languages, children are able to strengthen their overall PA and literacy skills (Logan & Johnston, 2009). The authors point out that it is a cycle, starting from the child's attitude to reading, how often and how much they enjoy reading activities and how much praise they receive. The children's parents and teachers act as role models to the children. It is therefore important for the children to see them give importance to literacy activities and to be encouraged to read books in both languages.

4.6.2 Method of literacy instruction and alphabet knowledge

Not all the children were reported to make use of the phonics approach in schools. Findings show that children who learned to read using the phonics approach obtained higher scores (MWB=72%; EWB=67%). This indicates that the phonics approach aids word blending skills. Since the children performed better in MWB, phonics approach may work better with languages with transparent orthographies. McGeown, Johnston, and Medford, (2012) predict that if children are taught to read using the phonics approach the most important skills for the child would be: letter knowledge, phoneme awareness and memory whilst vocabulary knowledge was only associated with reading development when children were taught to read using sight word reading. This statement is highly pertinent when considering the orthographic depths of the languages the child is faced with. In transparent languages such as Maltese, there is a higher consistency between spelling to sound correspondences than there is in English, the deeper orthography. In deep or opaque languages, with highly irregular spelling forms, the reader cannot rely on a '*sounding out*' strategy to access the word and subsequently its meaning. The child who is faced with both Maltese and English orthographies will benefit from a phonics instruction approach when learning how to read Maltese and regular English words (Agius, 2012). Sight words reading is a method of instruction that would be more beneficial to the child when faced with highly irregular spelling formats.

Children reported to have difficulties learning the alphabet, obtained a lower average score. Researchers note the link between alphabet knowledge and reading ability. Alphabet knowledge is important for children, because it introduces them to the issue of orthographic knowledge, which in turn, is essential for spelling and writing in beginners (Phillips, Piasta, Anthony, Lonigan, & Francis, 2012; Puranik, Petscher, & Lonigan, 2012). Phillips, Piasta, Anthony, Lonigan and Francis, (2012) agree that alphabet knowledge is an important skill needed for reading. If children are noted to experience difficulties with learning the alphabet extra support should be given to these children both in the home and at school. A child should have the opportunity to develop a decent foundation in alphabet knowledge in both Maltese and English so as to progress further in both language and literacy.

5 Conclusions

The aim of the current study was to investigate the word blending performance of Maltese 6 to 7 year-olds. One hundred (100) children attending State, Church and Private Schools were administered two word blending tests: (1) Blending Words subtest of the 2nd edition of the Comprehensive Test of Phonological Processing (CTOPP-2; Wagner, Torgesen, Rashotte & Pearson, 2013) and (2) Maltese Word Blending test developed for the purpose of this research. Performance was measured according to various independent variables including school type, school

language, home language, gender and ability. Parents were asked to complete a questionnaire related to language and literacy practices in the home. The main findings are:

1. Overall better performance in Maltese word blending tasks, when compared to English word blending tasks.
2. Girls performed better than boys.
3. State school performance was the highest in Maltese word blending, while Private school performance was the highest in English word blending. Church school children obtained the lowest mean scores in both Maltese and English word blending.
4. Typically developing children performed significantly better than children with reading difficulties.
5. Bilingual children performed better overall, than their monolingual counterparts.
6. Children who were reported to enjoy reading at home and who read more frequently obtained higher scores when compared to children who do not enjoy reading and who read less often.
7. Higher mean scores were obtained by children who liked to read in both Maltese and English, as opposed to reading in just one language.
8. Children who were taught how to read via the phonics approach performed significantly better than other children in both tests.
9. Children who were reported to have difficulties with learning the alphabet obtained significantly lower results in both tests when compared to children who had no difficulties with alphabet knowledge.

6 Limitations of the study

The limitations include:

Demography

The schools in which the study was conducted are all located in the central region of Malta. For this reason, results cannot be generalised to the performance of children attending schools located in other parts of Malta. The solution would be to include schools from different areas of Malta, for generalization to be possible.

Participant selection

Even though participant selection criteria were explained to the teachers, some of the children chosen to partake in the study were in fact not eligible (e.g. foreign children who did speak Maltese). For this reason, the sample size was slightly diminished. The participants were chosen following teachers' reports on the children's academic performance. Teachers may have been subjective in their choice. The solution here would be to be more specific in participant selection criteria and to use a standardised assessment to clearly identify the children's level of ability and to refer to academic scores and performance when selecting participants.

Sample size

Since some parents did not give consent for their children to be included in the study, the sample size was reduced. In future studies the researcher should ask more participants to partake in the study.

Duration of testing

The total time it took the children to complete both Maltese and English tests was measured. In future studies it would be of better value to measure the duration of each language version of the test individually so as to compare the duration of the Maltese test to that of the English test. This would lead to a better comparison of test duration between languages.

Questionnaire

There could have been more questions added to the parents' questionnaire in order to gain more information about the children participating in the study. A questionnaire could have been given to the respective teachers. Questions could have tackled areas such as: language of instruction and teaching methods used e.g. whether analytic or synthetic phonics approach is used. More detailed questions for the parents to answer should be given as well as a questionnaire given to the class teachers. The questionnaire was not piloted in the current study, therefore one would pilot the questionnaire in future studies to get an indication as to whether any changes need to be done.

Maltese assessment

The lack of a standardised Maltese assessment to test children's Maltese word blending skills is a limitation. The assessment used had no reliability or validity measures. When conducting future research, the researcher should see whether any new standardised Maltese assessments are developed and work on validation and standardisation.

7 Recommendations from research

Recommendations drawn out from the data include:

1. Children should be encouraged to read in both languages as this supports better performance in word blending and reading.
2. Children are to be encouraged to read more frequently at home, where family members should include literacy activities in their own daily life, in order to stimulate the children to partake in such activities too.
3. Language stimulation for children in State, Church and Private schools should include both languages. The use of both Maltese and English should enrich the children's oral and written language skills.
4. All schools should ensure that children in the younger years have an adequate grasp of alphabet knowledge so that literacy skills would have a good basis to develop on.

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10 Conflicts of interest

The authors report no conflicts of interest.

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Research paper

NON-MEDICAL USE OF PRESCRIPTION PSYCHOTROPIC DRUGS AMONGST UNIVERSITY OF MALTA STUDENTS

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Abstract. The non-medical use of prescription drugs (NMUPD), mostly psychotropic drugs, is registering an increase in prevalence worldwide, with emerging adults being considered a vulnerable group. In Malta, the evidence base for the prevalence of NMUPD is somewhat lacking, especially for this age group. This paper documents data on the prevalence of NMUPD among University of Malta (UOM) students and explores patterns of use including: age of initial use, source, motivation for use, and use of prescription drugs together with alcohol. The relationship of NMUPD with a number of socio-demographic variables is also examined. An anonymous online questionnaire distributed to the entire UOM student population was used to collect the data. Of the 347 students who completed the questionnaire, 7% reported lifetime non-medical use of opioids, 3.5% reported lifetime non-medical use of CNS depressants and 2.8% reported lifetime non-medical use of CNS stimulants. Consistent with the literature on the subject, female students reported higher engagement in NMUPD than males. The paper concludes with a number of recommendations.

Keywords: Non-medical use of prescription drugs, emerging adults, Malta, university students

1 Introduction

While the non-medical use of prescription drugs (NMUPD) is reported to be on the rise across the globe (UNODC, 2011), the real dimensions of the phenomenon are difficult to ascertain due to a number of challenges in monitoring (Clark, 2015). The 2013 report by the the Council of the EU (Lithuanian Presidency) states that: "Gaps in monitoring prescribing patterns of licit controlled medicines and difficulties in detecting the population who misuse prescription medicines have made the definition of the extent

and the severity of the problem across Europe particularly challenging thus far" (Lithuanian Presidency of the Council of the EU, 2013, p. 7). This paper is important because it attempts to fill a research gap by exploring the prevalence of NMUPD among the Maltese university population.

In this paper, NMUPD is defined as "the taking of prescription drugs, whether obtained by prescription or otherwise, other than in the manner or for the reasons or time period described, or by a person for whom the drug was not prescribed" (Lithuanian Presidency of the Council of the EU, 2013, p. 14) and is concerned with the misuse and abuse of psychotropic drugs. Three main classes of prescription drugs are used non-medically (Clark, 2015): opioids (eg hydrocodone (Vicodin®), oxycodone (OxyContin®, Percocet®), morphine (Kadian®, Avinza®), codeine®), CNS depressants (benzodiazepines, such as diazepam (Valium®) and alprazolam (Xanax®) and barbiturates, such as mephobarbital (Mebaral®), sodium phenobarbital (Luminal®) and sodium pentobarbital (Nembutal®), and CNS stimulants (methylphenidate (Ritalin®, Concerta®), dextroamphetamine (Dexedrine®) and mixed-salts amphetamine (Adderall®).

In 2010, the United Nations Office on Drugs and Crime (UNODC) and the World Health Organisation (WHO), identified NMUPD as a novel threat to public health. In the US, the 2014 National Survey on Drug Use and Health, estimated that 2.1 million Americans initiated NMUPD that year. More females than males initiated NMUPD, and of the new users 30% were adolescents (SAMSHA, 2015). Prescription opioid use, is a challenging problem in the US, with use increasing fourfold in three decades (Volkow & Compton, 2006) and exceeding the use of illicit drugs. In the US in 2014, NMUPD was most common among emerging adults aged 18 to 25. In this group, 4.4% reported nonmedical use in the last 30 days. Among the 12 to 17 age group, 2.6 % registered NMUPD in the last 30 days (SAMSHA, 2015). In both the US and in Europe University students may be at greater risk for NMUPD, due to ease of access of drugs in university settings and the likelihood of their peers sharing prescription drugs (McCabe, Teter, & Boyd, 2006). In Europe, the 2015 ESPAD report highlights how the non-medical use of CNS depressants was common amongst 16 year olds with 17% in Poland and 16% in the Czech

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Republic. The use of substances is gendered and one finds that in Europe girls are more likely than boys to use non-prescription tranquillisers or sedatives. While the gender gap for substance use has been consistently decreasing, in the case of NMUPD this gap is reversed (Clark, 2015). Young people who engage in NMUPD also tend to use other licit and illicit substances. Particularly worrying is the evidence based prediction that those who use prescription opioids at an early age tend to also use illicit opioids when older (McCabe, 2012).

In Europe, NMUPD is only monitored in some countries (UNODC 2011: 6) and there is lack of consistency and comparability in the available data (Clark, 2015). Casati et al. (2012) claim that “although awareness of the misuse of medicines is increasing, data on the extent of the problem in the European Union are lacking” (Casati et al, 2012: p.228). Apart from the misuse of opioid substitution drugs, NMUPD has not, in Europe, been treated as a major problem (UNODC, 2011: 8). In a 2012 review of the research on NMUPD in Europe, Casati et al. reported disquieting figures for some European states. A postal survey in Scotland reported 37% prevalence of non-medical use of opioids. Females were more at risk than males (Porteous et al, 2005). In a study investigating prescription drugs in Norway (Bramness et al, 2007), 0.5% of respondents claimed that they have taken more than what was prescribed for them. A study in France showed that there are high levels of codeine misuse and a significant risk of fentanyl abuse and dependence (Cazorla et al, 2007).

A Council of Europe study on the gender dimension of NMUPD in Europe and the Mediterranean (Clark, 2015) identified females as being at higher risk for NMUPD. Gender, however, is not always predictive in the same manner for the different types of substances. Clark (2015) highlighted that women’s addictive career paths are characterised by telescoping and that emotional self-medication may be a motivating factor for NMUPD amongst women. Clark (2015) analysed data submitted by expert respondents from 17 countries and showed how in the general population, women used more prescription drugs more than men across all time periods (life time, last year and last thirty days). Use increased with age (Clark, 2015). The study found higher levels of NMUPD for women than men in Greece, Lithuania and Serbia, and the reversal in Israel and Lebanon. A prescription from a medical professional was most commonly cited source for both genders, followed by “from a friend or a relative”. This shows how easily prescription drugs may be diverted. The study reports that in Lithuania sedatives and tranquillisers obtained without a doctor’s prescription are more likely to be used by women aged between 45 and 64, people with a higher educational qualification, divorced or widowed people and the unemployed. Fatal overdoses related to prescription drugs had higher rates for women than men in Serbia and Germany (Clark, 2015).

In the Maltese context, the 2015 ESPAD report (Arpa, 2016) showed how 5% of 16 year olds drank alcohol together with pills to get high, 3% used pain relief medication to get high and 3% used CNS depressants without a prescription. A general population survey (GPS) conducted in Malta in

2001 (Korf & Benschop), reported that 14.9% of respondents used sedatives or tranquilizers once in their lives. Twice as many females than males made use of sedatives or tranquilizers in lifetime (Korf & Benschop, 2001). A more recent GPS showed a decline of use among both males and females but the gender difference remains very evident.

Emerging adults have been recognized as having heightened vulnerability for NMUPD (Clark, 2015). In the US, university students were found to have the highest rates. In US colleges, the annual prevalence of NMUPD rose from 8.3% in 1996 to 14.6% in 2006, whereas over this same period of time the prevalence of marijuana declined (SAMHSA, 2015). Social and academic stressors and ease of access of drugs and alcohol at university (Nock et al, 2008) were considered to lead to psychological difficulties among this group. Research amongst British university students showed that from those students who did not have any psychological problems prior to enrolling to university, 9% had developed symptoms of depression, and 20% has anxiety issues, while 26% who already had anxiety prior to starting university had developed depressive symptoms mid-way through the course. With regards to psychosomatic and psychological conditions, when comparing university students with their average peers who do not attend university, students have been found to be less healthy (Andrews & Wilding, 2004). In a study conducted with Malta University students (Cefai & Camilleri, 2009), 77% regularly suffered from exhaustion, 63% frequently experienced anxiety, 49% reported having headaches regularly, 46% frequently felt down, 16% had anxiety (compared to 2% in the general population), and 10% reported depression (compared to 1% in the general population). Furthermore, 3.4% claimed that they take sleeping tablets/tranquilizers (Cefai & Camilleri, 2009). Researchers report that students at university are more prone to mental than physical health difficulties (Stewart-Brown et al, 2000; Tinklin et al, 2005; ACHA, 2009).

2 Methods

This study investigated the prevalence of psychotropic prescription drug use and NMUPD amongst university students for lifetime, last year and last month use. It also included patterns of use including: age of initiation of NMUPD, types of prescription substances used, source, motivations for use, use of NMUPD with alcohol, as well relationships with gender, age, locality, employment, civil status and progression in the course of study. The study used an online questionnaire deployed to the entire student population (n= 11,500) at the University of Malta via eSIMS, an electronic Student Information Management System available to all University students in the spring of 2015. The questionnaire was constructed following a consultation of existing questionnaires exploring drug use namely: *ESPAD* (Hibell et al, 2003); *The Gender Dimension of Non-Medical Use of Prescription Drugs* (Clark, 2015); *Healthy Students Healthy Lives: The Health of Maltese University Students* (Cefai & Camilleri, 2009); and the *Use of Alcohol, Tobacco and other drugs in Malta, Report 2013* (Muscat et al, 2014).

The questionnaire was divided in 8 sections. The first section introduced the questionnaire and explains the research, the second asked about demographics, the third explored knowledge of prescription drugs and explains the various substances, the fourth explored patterns of use, the fifth explored the source of prescription drugs, the sixth attended to motivations, the seventh explored the participant's beliefs of consequences and the final section allowed for participants' comments. The sampling frame consisted of all the University of Malta students. The data was exported from SURVEYMONKEY, into IBM SPSS for statistical analysis and converted into categorical variables analysed as frequency data. The association between categorical variables was tested using the chi-square test. Since the research design utilized an anonymous online questionnaire, the responses to which could not be traced back to the respondents, ethical clearance was not sought from UREC. The study methodology was endorsed by the Psychology Dissertations Committee.

3 Results

3.1 Sample Decomposition

The response rate was 3.5%, with a total of 397 individuals completing the questionnaire. Female respondents were 70.5% and 29.5% were male. The highest proportion of the respondents were aged 20-22 years (38%) and were from the Northern Harbour district (31.82%). 6.82% were from Gozo. Respondents were mostly single (82.2%), followed by married (12.2%), cohabiting (3.8%) and separated or divorced (1.8%). 80.6% of the students were undergraduates while 19.4% were postgraduates. 44.9% of the students were in employment, mainly part-time, and studying.

Table 1. Gender and Medical Use of Opioids

			Gender		Total
			Male	Female	
Have you ever taken opioids because a doctor prescribed them to you?	Yes	Count	13	28	41
		% within Gender	16.0%	13.6%	14.3%
	No	Count	57	167	224
		% within Gender	70.4%	81.1%	78.0%
	Don't Know	Count	11	11	22
		% within Gender	13.6%	5.3%	7.7%
Total		Count	81	206	287
% within Gender		100.0%	100.0%	100.0%	

$$X^2(2) = 6.248, p = 0.044$$

3.2 Medical Use of Prescription Drugs

Fourteen point two percent reported lifetime use of medically prescribed opioids. A higher proportion of males (16%) than females (13.6%) reported taking opioids because a doctor prescribed them ($p = 0.044$) (Table 1). Older students were more likely to report having been prescribed opioids ($p = 0.002$). Students were more likely to have been prescribed opioids if they were further advanced in their academic career ($p = 0.023$). There were no significant relationships between opioid use and district, employment and civil status.

Ten point six percent of the respondents reported use of medically prescribed CNS depressants in lifetime. Students were more likely to have been prescribed CNS depressants if they were older ($p = 0.03$). No statistical significant difference was found when testing for relationships between medical use of CNS depressants and gender, district, civil status, employment and year of study. 4.6% of the participants reported ever medical use of CNS stimulants. No statistical significant correlations were found between lifetime medical use of stimulants and district, gender, civil status, employment and progression in one's course of studies.

3.3 NMUPD

Table 2 illustrates lifetime, last year and last month non-medical use of opioids, CNS depressants and CNS stimulants.

Table 2. Prevalence Rates of Opioids, CNS Depressants and CNS Stimulants

	Lifetime	Last Year	Last Month
Opioids	7%	4.2%	0.7%
CNS Depressants	3.5%	2.8%	0%
CNS Stimulants	2.8%	1.4%	0%

Students reported higher use of non medically prescribed opioids in lifetime last year and last month.

Table 3 shows how females registered higher prevalence rates of ever use of non medically opioids ($p = 0.010$). Higher prevalence rates are again registered for females in last year ($p = 0.011$). No statistically significant differences were found for age, district, year of study, employment and civil status at lifetime and last year use. 0.7% of students reported the

non-medical use opioids in the last month, however no statistical differences were found between groups.

Table 3. Gender and Lifetime Non-Medical Use of Opioids

			Gender		Total
			Male	Female	
Have you ever taken opioids without a doctor's prescription?	Yes	Count	5	15	20
		% within Gender	6.3%	7.3%	7.0%
	No	Count	67	188	255
		% within Gender	84.8%	91.3%	89.5%
	Don't Know	Count	7	3	10
		% within Gender	8.9%	1.5%	3.5%
Total		Count	79	206	285
% within Gender		100.0%	100.0%	100.0%	

$X^2(2) = 9.262, p = 0.010$

Table 4 documents how a higher percentage of female lifetime was found to make use of CNS depressants (3.9%) ($p = 0.018$). 2.9% of the female students made non-medical use of depressants in last year compared to 1.3% of males ($p = 0.023$). No differences were found regarding age, district, employment, civil status and progression in course of studies.

Table 4. Gender and Lifetime Non-Medical Use of CNS Depressants

			Gender		Total
			Male	Female	
Have you ever taken CNS Depressants without a doctor's prescription?	Yes	Count	1	8	9
		% within Gender	1.3%	3.9%	3.2%
	No	Count	72	197	269
		% within Gender	92.3%	95.2%	94.4%
	Don't Know	Count	5	2	7
		% within Gender	6.4%	1.0%	2.5%
Total		Count	78	207	285
% within Gender		100.0%	100.0%	100.0%	

$X^2(2) = 8.802, p = 0.018$

Two point eight percent of students reported lifetime use of CNS stimulants, however no statistically significant differences were found for gender, age, civil status, employment, year of study and district. One point four percent of students took CNS stimulants non-medically in the last year. No statistically significant differences were found in the correlations between demographic variables.

3.4 Age of first use

Of those who reported NMUPD, 34% reported having first used the substance, not necessarily non medically, between the age 11 to 16, 32% between the ages of 17 to 19 and 34%

reported having been over 20 at first use. The modal age for onset of use of a prescription drug was found to be 16 years of age.

3.5 Source and motivation

The most commonly reported source of prescription drugs was a licit one, such as previously prescribed by the doctor to the student (44.82%). This was followed by bought without a prescription from a pharmacy (22.41%), got them from somebody else (15.52%), other methods (1.72%) and fake prescriptions (1.72%). Of those who had the drug previously prescribed by doctor, 18.95% reported taking prescription drugs to self-medicate. 4.03% reported using the drugs because they were curious, 2.82% reported using the drugs to feel relaxed and 1.61% reported using the drugs to feel high.

3.6 Stress

Over all, females reported experiencing more stress at University than males (Table 5).

Table 5. Gender and Stress

		Gender	
		Male	Female
How stressful are you finding this academic year?	Very stressful	19.0%	32.8%
	Stressful	22.8%	36.3%
	Somewhat stressful	46.8%	25.4%
	Not stressful	11.4%	5.5%
Total		100.0%	100.0%

3.7 Alcohol and prescription drugs

Ninety one point three percent of respondents reported lifetime use of alcohol. 1% of the respondents always mix prescription drugs with alcohol, 10.1% sometimes mix alcohol with prescription drugs and 16.4% rarely mix both. No statistically significant correlations were found between the demographic variables.

4 Discussion

Youth researchers note that the transition to adulthood is becoming increasingly protracted and complex to negotiate and that "long-term demographic change, shifts in economic and educational structures, and recent social policy decisions" (Hall, Williamson & Coffey, 1998), are providing youth with increased challenges in negotiating complex transitions. The period of emerging adulthood, coined by Arnett, (2000) to discuss this specific life period, is characterized by identity exploration, some degree of instability and self focus. It is an age of feeling in-between, in transition, neither adolescent nor adult, marked by heightened differentiation in life trajectories (Arnett, 2000). This is due, in part, to the negotiation of pathways that may have earlier been curbed, as well as to the availability

of new trajectories. While it is a period where individuals experience a number of hopeful prospects and have an unparalleled opportunity to redirect their pathways, it is also a challenging period where the individual is typically required to make major adjustments, develop new competencies, and learn to cope with new experiences precipitating stress. This, combined with increased independence and freedom from adult supervision, may make emerging adults at risk of increased substance use. While the transition from adolescence to adulthood is a critical juncture for the development of health behaviours (Lara-Torre, 2008), emerging adults often do not think how their lifestyle choices will affect their wellbeing.

The need to intervene at this critical point in time is highlighted. Young people may experience stress, leading them to seek medical assistance. This study testifies to the preoccupying rates of both medically prescribed and non medical prescribed drug use by emerging adults in Malta and alerts to the readiness of medical practitioners to prescribe substances that are potentially dependence producing. The result indicate that University students may be at heightened risk due to the stresses of academic life and perhaps due to the fact that almost half of the sample were also working while pursuing an academic career. This substantiates the findings of Cefai and Camilleri (2009) discussed above.

This specific study has shown how opioids are the most commonly used prescription drugs and are used both according with medical practice (by prescription) and otherwise. Opioids are mainly prescribed for pain relief, but taken in high doses may bring about euphoria and have high abuse potential. While emerging adults may be taking these medications initially for pain relief, 7% of respondents claim to have used them non-medically. Studies in the US show an increase in the likelihood of developing an opioid use disorder amongst this cohort (Edlund et al, 2014).

While no significant gender differences were reported with regards to lifetime or last year use of stimulants, higher rates of lifetime use of opioids and depressants, and last year use of opioids and depressants, were reported by females. This coincides with ESPAD's findings from 1999, 2003 and 2011 which all clearly portray gender differences (typically, females report 3-4% more NMUPD than males). This research shows an unambiguous gender difference with regards to NMUPD, with females having higher prevalence rates than males. A similar vulnerability of women to the non medical use of prescribed drugs is registered in other studies (Simoni-Wastila et al., 2004).

While the gender gap for treatment demand for illicit substances in Malta continues to be wide, with the absolute majority of those in treatment being males (MFSS, 2016), women may be at increased risk of misusing medicines because illegal drug abuse is stigmatised even more strongly amongst women (Hecksher & Hesse 2009). Besides associated stigma, prescription drugs are easier to get hold of than illicit substances and the chance of arrest is minimal (Rigg & Ibanez 2010). The social acceptability of their

use and their perceived safety are also influencing factors. Clark (2015) highlights the role of trauma and interpersonal violence in female NMUPD. Women often use these drugs to cope with relational stress and negative emotional states. The abuse of prescription medications by females may be linked to their experience of psychological distress and stressful life situations including violence (Back et al., 2011). The accelerated disease progression observable among women who engage in NMUPD means that females come to use them regularly more quickly, thus "the window of opportunity for preventing progression is smaller for women" (Back et al., 2011:p 833).

Early onset of non-medical use of prescription drugs, can have effect both on the outcome of future prescription drug abuse and later addictive involvement with substances; an increase of one year in the age of onset reduces the chances of dependence of abuse by 5% (McCabe et al., 2007). In this research, the two most popular ages of initiation to prescription drug use were 16 and 18. 20% of the students were 16 years old when they first made use of prescription drugs and 14% were 18 years old. This has important implications with addressing this age group through prevention efforts.

According to this research, the three most commonly reported sources of prescription drugs were "previously prescribed by a doctor" to the student (44.83%), followed by "bought without a prescription from a pharmacy" (22.41%), followed by "got them from friends or relatives" (15.52%). The most common source concurs with the results of the study by Clark et al. (2015:p. 93). The sources reported in this research were similar to the sources identified by SAMHSA in 2008 in a study of people aged 12 or over. However, Maltese university students also reported having bought them in a pharmacy without a prescription. This might alert one to the ease of getting medication without a prescription in a close-knit Maltese community, where everyone knows each other and has important policy implications.

Previous research, highlights students' NMUPD as being motivated by the need to self-medicate physical or emotional distress (Fords & Schroeder, 2009; McCabe et al., 2009; McCauley et al., 2009; McCauley et al., 2011; Teter, Falone, Cranford, Boyd & McCabe, 2010; Wu et al., 2008). The findings of this study resonate with this. While, in the US, students reported using stimulants to help them stay focused (Burgard et al., 2013; Garnier-Dykstra et al., 2012; Hanson et al., 2013; Rozenbroeck and Rothstein, 2011), in this research stimulants were the least common drugs used non-medically amongst University of Malta students.

This study highlights how more than 60% reported that they are finding this year stressful, 38% are finding it somewhat stressful. Students may experience psychological distress and in an attempt to cope, put themselves at risk for NMUPD. Females experienced more stress than males. In a 2012 study amongst US students, sad and depressive feelings were predictive of non-medical use of prescription drugs, mostly with opioids (Zullig & Divin, 2012). Females heightened stress may be placing them at a higher risk.

4.1 Limitations

The main limitations of this study are related to the sampling design. While the entire student population received the questionnaire, the sampling methodology did not utilise a systematic random sample and so the results are not generalizable. The non probability sampling technique can only give us information about those who answered the questionnaire. The convenience sample may have led to the under-representation or over-representation of particular groups within the sample. Despite this severe limitation, the study was aimed at being exploratory in nature and given the dearth of knowledge on NMUPD amongst emerging adults in Malta, this initial data may be seen to indicate trends amongst this group and provide indications for areas of further research. Another limitation is the response rate which was rather low, 3.5%, with a total of 397 university students completing the questionnaire. Another limitation concerns the interpretation of the items on the research tool. Since the survey was administered through an anonymous online questionnaire, it is also unknown whether the respondent answered their questions truthfully or if they understood what was being asked. This is however a limitation plaguing all self-report studies of substance use. Additionally, some questionnaires were submitted incomplete and needed to be discarded. A main limitation is that the study surveyed only university students who are a very particular group of young people and therefore the results cannot be generalised to other categories of youth.

5 Recommendations

A number of recommendations for further research, policy and practice emerge from this initial exploratory study. Reporting on the extent of NMUPD needs to become a priority in Malta, as elsewhere. Empirical investigations on NMUPD which tackle specific issues, such as the onset, acceleration, physical and psycho-social consequences for emerging adults as an “at risk” category are also due. Researchers need to develop monitoring systems for NMUPD that include other categories of prescription drugs, in addition to CNS depressants and that ask about the source of prescription drugs. In terms of practice (prevention and treatment), and given the evident gender gap in the data on NMUPD, this study recommends differentiated remedies for women and girls. Guidelines for prescription practices need to be developed, ensuring that while persons who need psychotropic prescription drugs, have access to them, this does not result in unnecessary prescriptions for these drugs, which might consequently find themselves diverted. A priority is also the development of education programmes aimed at the general public that advises on how to use medicines safely and store and dispose of them appropriately. Medical practitioners need to be trained to be able to assess and identify individuals at risk of NMUPD. This study also recommends that coherent policies addressing the use and misuse of medicinals, with specific reference to age and gender differences, be developed in Malta.

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8 Conflicts of Interest

The authors report no conflicts of interest

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Appendix A

NON-MEDICAL USE OF PRESCRIPTION DRUGS AMONG UNIVERSITY STUDENTS

Welcome to My Survey

Dear student,

The aim of this study is to gather knowledge on the prevalence of non-medical use of prescription drugs (NMUPD) among university students. The Lithuanian Presidency of the Council of the EU in 2013 defined NMUPD as the: “use of a prescription drug, whether obtained by prescription or otherwise, other than in the manner or for the time period prescribed, or by a person for whom the drug was not prescribed”. For the purpose of this survey, prescription drugs are defined as pharmaceutical drugs which require a medical prescription to be dispensed.

This survey is strictly anonymous, and you are free to quit at any point, however your response is greatly appreciated.

Thanks

Demographics

The aim of this section of the survey is to gather some basic statistical data of the respondents. Any data and information given here and in any part of the survey is strictly anonymous.

1 Sex

☐ Male ☐ Female ☐ other

2 What is your age?

3 Where do you currently reside?

4 What is your civil status?

5 At which faculty/institute/centre are you studying?

6 Which study level are you in?

☐ Undergraduate ☐ Postgraduate

7 Which year are you in?

☐ 1 ☐ 2 ☐ 3
☐ 4 ☐ 5 ☐ 6

8 What is your attendance mode?

☐ full-time student
☐ part-time student

9 Are you currently employed?

☐ yes ☐ no

Knowledge on Prescription Drugs

Prescription drugs are pharmaceutical drugs which require a medical prescription to be dispensed, contrary to over-the-counter drugs which can be obtained without a prescription.

10 Opioids are medications prescribed by doctors to relieve pain (strong pain killers), such as Vicodin[®], Oxycotin[®], Duragesic[®], Kadian[®], etc. Have you ever heard of opioids?

☐ yes ☐ no

11 Do you think that opioids have any of the following side effects?

	yes	no	don't know
drowsiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
mental confusion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nausea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
constipation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
depress respiration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
euphoric feelings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12 Do you think that opioids can lead to physical dependence or addiction?

☐ yes ☐ no ☐ don't know

13 Do you think people may experience the following symptoms when withdrawing from opioids?

	yes	no	don't know
agitation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
anxiety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
muscle aches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
gastrointestinal distress	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14 CNS depressants are medications prescribed by doctors to treat anxiety and sleep disorders, also known as tranquilizers or sedatives ("kalmanti"). Types of CNS depressants are Valium®, Xanax®, Halcion® and ProSom®. Have you ever heard of CNS depressants?

☐ yes ☐ no

15 Do you think that CNS depressants have any of the following side effects?

	yes	no	don't know
drowsiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
incoordination	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

16 Do you think that CNS depressants can lead to physical dependence or addiction?

☐ yes ☐ no ☐ don't know

17 Do you think withdrawing from CNS depressants abruptly can have severe effects, even life-threatening?

☐ yes ☐ no ☐ don't know

18 *CNS stimulants or amphetamines increase alertness, energy and elevate blood pressure and respiration. Stimulants are mostly prescribed by doctors to treat ADHD, narcolepsy, and occasionally as a last resort to treat depression. Types of stimulants are Dexedrine[®], Adderall[®], Ritalin[®] and Concerta[®]. Have you ever heard of CNS stimulants?*

☐ yes ☐ no

19 *Do you think CNS stimulants have any of the following side effects?*

	yes	no	don't know
increased heart rate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
increased blood pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
constricted blood vessels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
increased blood glucose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
opening of breathing passages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
anorexic effects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
heightened attention	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
wakefulness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
hallucinations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
euphoria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
altered perception	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20 *Do you think that CNS stimulants can lead to physical dependence or addiction?*

☐ yes ☐ no ☐ don't know

21 *Do you think that people may experience the following symptoms when withdrawing from CNS stimulants?*

	yes	no	don't know
fatigue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
depression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
sleep disturbances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Patterns of use

This section examines the patterns of use of the non-medical use of prescription drugs and illicit drugs. For the purpose of this survey, “non-medical use” means using the drugs without a doctor’s prescription or not as prescribed. “Non-medical use” also includes being previously prescribed the drug by the doctor, and then consuming the drug later after the prescription expired or not as the prescription states.

22 Have you ever taken any of the following because a doctor *PRESCRIBED* them to you?

	yes	no	don't know
Opioids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS depressants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS stimulants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

23 If yes to any of the above, what was the reason you were prescribed the drug?

24 Have you ever taken prescription drugs non-medically?

☐ yes ☐ no ☐ don't know/don't remember

25 Have you ever taken any of the following drugs *WITHOUT* a doctor's prescription?

	yes	no	don't know
Opioids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS depressants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS stimulants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

26 During the past year, have you ever taken any of the following drugs without a doctor's prescription?

	yes	no	don't know
Opioids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS depressants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS stimulants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27 Have you ever used any of the following drugs non-medically in the past month?

	yes	no	don't know
Opioids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS depressants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS stimulants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

28 During the past 30 days, on how many days did you take prescription drugs non-medically?

	yes	no	don't know
Opioids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS depressants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CNS stimulants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

29 *In your lifetime, did you ever make use of the following?*

	yes	no	don't know
alcohol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
marijuana	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
cocaine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ecstasy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
amphetamines (uppers, pep pills, bennie, speed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LSD or other hallucinogens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
crack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
heroin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"magic mushrooms"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

30 *Do you ever mix prescription drugs with the following?*

	yes	no	don't know
alcohol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
marijuana	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
cocaine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ecstasy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
amphetamines (uppers, pep pills, bennie, speed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LSD or other hallucinogens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
crack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
heroin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
"magic mushrooms"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

31 *What was your age the first time you took prescription drugs non-medically?*

Sources

This page examines sources of prescription drugs and ease of obtaining drugs. All information is strictly anonymous.

32 *The last occasion you took prescription drugs, how have you obtained them?*

- ☐ fake prescription
- ☐ were previously prescribed by a doctor for oneself
- ☐ got them from somebody else (friend/relative)
- ☐ bought them without prescription in a pharmacy or drugstore

- ☐ bought them over the internet
- ☐ other
- ☐ never took prescription drugs

33 *How difficult is it for you to obtain prescription drugs without a prescription?*

- ☐ impossible
- ☐ very difficult
- ☐ fairly difficult
- ☐ fairly easy
- ☐ very easy
- ☐ don't know

Motivation

This part of the survey tries to identify any possible reasons which may be motivators for using prescription drugs non-medically.

34 *If you ever took prescription drugs non-medically, what was the reason for doing so?*

- ☐ I never took prescription drugs non-medically
- ☐ I wanted to feel high
- ☐ To feel relaxed
- ☐ I was curious
- ☐ To self-medicate (drug already prescribed previously by doctor)
- ☐ To self-medicate (drug never prescribed previously by doctor)
- ☐ Other (please specify) _____

35 *Do any of your friends/family make use of prescription drugs non-medically?*

	none	few	some	most	all	don't know
Friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

36 *How stressful are you finding this academic year so far?*

- ☐ very stressful
- ☐ stressful
- ☐ somewhat stressful
- ☐ not stressful

37 *Within this academic year, what strategies did you use most to cope with stress? You can select more than one*

- ☐ studying harder
- ☐ better planning and organisation

- ☐ asking help from lecturers and colleagues
- ☐ counselling
- ☐ family support
- ☐ talking with friends
- ☐ praying
- ☐ positive thinking
- ☐ time management
- ☐ cutting on leisure activities
- ☐ physical exercise
- ☐ drinking
- ☐ going out/partying
- ☐ avoidance/running away
- ☐ smoking
- ☐ comfort eating
- ☐ yoga/progressive relaxation
- ☐ watching television
- ☐ prescription drugs
- ☐ illicit drugs
- ☐ Other (please specify) _____

Consequences

Finally, this page attempts to identify to perceptions of the consequences of the non-medical use of prescription drugs.

38 How much do you think people risk harming themselves (physically or in other ways), if they...

	no risk	slight risk	moderate risk	great risk	don't know
take opioids non-medically once or twice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
take opioids non-medically regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
take CNS depressants non-medically once or twice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
take CNS depressants non-medically regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
take CNS stimulants non-medically once or twice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
take CNS stimulants non-medically regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The end!

39 Thanks for filling out this survey, should you have any further comments please leave them in the comment section below :)

Research Paper

INVESTIGATING THE SPELLING PERFORMANCE OF MALTESE CHILDREN

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Abstract. This research investigates Maltese word and non-word spelling abilities of Maltese children. A total of 82 typically developing students attending state and church schools in grades 4, 5 and 6 participated in the research. Spelling abilities were assessed using a standardized Maltese spelling test and a non-word spelling test developed for the purpose of this study. A comparison of the children's performance in these tests was undertaken in terms of their grade, gender, school-type, school language and home language. Findings show that word and non-word spelling abilities are only significantly affected by grade and school-language. Spelling patterns were analyzed and discussed in light of the dual route model. Four distinctive categories of spelling patterns emerged in this study, which indicated the use of lexical and sub-lexical processes. Overall, findings are discussed in relation to other similar studies.

Keywords: spelling, non-words, dual-route model, literacy, spelling errors, Maltese.

1 Introduction

The relationship between oral and written language is exemplified by the predecessor language skills required for literacy development. Phonological processing skills and language skills including vocabulary, morphology, concepts of prints, sentence correction and processing contribute to reading and spelling abilities. Language skills are necessary for reading comprehension abilities (Fraser & Conti-Ramsden, 2008; Lonigan, Schatschneider & Westberg, 2008). Phonological awareness skills contribute to phoneme-to-grapheme mapping in spelling development (Weinrich & Fay, 2007; Al Oitaba, Puranik, Rouby, Greulich, Sidler & Lee, 2010). Therefore literacy instruction should start with the reinforcement of oral language skills (Rose, 2006).

Many studies looked into the development of spelling and its relation to language skills. Spelling development was initially thought to be a memorization process however researchers started realizing that sound-letter correspondences and phonological awareness skills play a role. As a result, theories of spelling development emerged. According to stage theories, spelling is acquired in stages. Gentry (1982) describes five stages of spelling development. In the *precommunicative* stage children acquire preliminary perceptions about writing; in the *semiphonetic* stage children develop awareness about sound-letter correspondences. In the third *phonetic* stage children's spelling is more conventional and in the *transitional stage* children represent all the letters and morphologic elements. In the final *correct stage*, children's spelling corresponds to their educational level. Ehri (1986) lists three stages which are similar to Gentry's (1982) *semiphonetic*, *phonetic* and *transitional* stages.

These theories, albeit not recent, are successful in providing a simplistic framework of spelling development. However, they are based on English and thus are limited in explaining other languages such as the Maltese/English bilingual context in this study. Spelling development is known to be highly influenced by the specific orthography of the language (Bear, Helman, Templeton, Invernizzi & Johnston, 2007). In Italian spelling development, children mastered phoneme-grapheme conversions earlier in the third grade (Notarnicola, Angelleli, Judica & Zoccolotti, 2012). Similarly, Finnish children incorporated the language's inflectional morphemes in their spelling earlier than initially believed (Lehtonen & Bryant, 2005). Specific linguistic factors including phonological awareness, orthographic knowledge and mental graphemic representations contribute to spelling development in that language (Apel, Masterson & Hart, 2004a). These linguistic factors should therefore be considered in spelling instruction and research on spelling.

Indeed, the Orthographic Depth Hypothesis (ODH) (Katz & Frost, 1992) states that spelling is shaped by the language's orthography. Languages differ in the way phonology is represented (Frost, 2005) and languages that represent their phonology with direct phoneme-to-grapheme correspondences are called *shallow* or *transparent* orthographies (example Finnish and Hebrew). Languages with more complex phoneme-grapheme correspondences

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are called *deep* or *opaque* orthographies (example English and French). Agius (2012) referred to Maltese as a semi-transparent language because it has direct phoneme-to-grapheme correspondences (Hoberman, 2007) but also has exceptions. Spelling acquisition differs according to the language's orthography. Spelling may develop faster in Maltese than English since Maltese is a semi-transparent language (Aguis, 2012).

In the case of bilinguals, spelling development is more complex (Joy, 2011) and different from monolinguals' developmental trajectories (De Sousa, Greenop & Fry, 2011). Bialystok (2002) comments that bilinguals must possess awareness of sounds, words and print in both languages as children with poor oral language skills in preschool were found to have later difficulties in literacy acquisition (Puranik & Lonigan, 2012). There may be positive and negative transfers/effects between L1 and L2 literacy. Agius (2012) found that Maltese spelling is predicted by English spelling fluency. This study explores spelling performance and patterns of bilingual Maltese/English children.

The Dual Route Model (DRM) explains spelling of familiar and unfamiliar words through two processes; the lexical and sub-lexical (Tainturier & Rapp, 2001). Both routes are activated by written input, but the sub-lexical is activated more by novel words, non-words and words with regular grapheme-phoneme correspondences. The lexical route is activated by words stored in the lexicon and words with irregular grapheme-phoneme correspondences (Bates, Castles, Luciano, Wright, Coltheart & Martin, 2007). Cognitive neuropsychology suggests that there is an interaction between the two processes because non-word spelling requiring sub-lexical activation is influenced by real words activated by the lexical route (Tainturier & Rapp, 2001). The sub-lexical route of the DRM is therefore highly utilized in Maltese writing (Agius, 2012) because of its direct phoneme-to-grapheme conversions. However, De Sousa et al. (2011) showed that both routes are utilized in a transparent orthography. Maltese ignores phonological processes like final consonant devoicing and voicing assimilation in writing (Hoberman, 2007). This implies that a strict application of the sub-lexical route would result in spelling errors. The Maltese grapheme *h* and digraph *gh* may also be a source of confusion. These letters are consonants in final positions but have no phonetic value in initial and middle positions (Hoberman, 2007). This study aims to utilize error analysis to investigate the application of the DRM in Maltese word and non-word spelling.

There are multiple classification systems of spelling patterns, however the majority "have concerned English words and are therefore limited to the linguistic and orthographic idiosyncrasies" (Potopapas, Fakou, Drakopoulou, Skaloumbakas & Mouzaki 2013, p.616). Consequently, studies in different languages utilized different classification systems that acknowledge specific language properties. Snowling (1987) distinguishes between *phonological* and *orthographic* errors. Phonological errors alter words' pronunciation while orthographic errors involve incorrect letters. Moats (1995) also included morphological errors in Snowling's (1987) system. Potopapas et al. (2013) classified

errors in Greek (transparent language) into phonological, grammatical, orthographic, stress, punctuation and other defined errors. Similarly, this research classified Maltese spelling patterns using a classification specific to Maltese but influenced by the above studies.

This study is driven by the following research questions:

1. How do Maltese children perform in Maltese word and non-word spelling?
2. What spelling patterns are more associated with sub-lexical processing and what spelling patterns are more associated with lexical processing in the dual route model?
3. What do these spelling patterns indicate about the children's knowledge of Maltese spelling?

2 Methods

2.1 Participants

In total, 82 students were included in the study (Table 1). The participants were recruited from three church and three state schools in Malta. All participants were required to be from grades 4-6 and typically developing. Typically developing refers to the absence of difficulties in academic attainment, speech and language development, literacy, emotional, physical or cognitive development. Spoken languages at home and school were identified through the questionnaires' (Xuereb, 2009) survey responses. Ethical approval from the University of Malta Research Ethics Committee was granted (reference number: 038/2013).

Table 1. Sample characteristics

Variables		Frequency
Gender	Males	40
	Females	42
Grade	4	26
	5	27
	6	29
School-type	Church	37
	State	45
Home Language	Me	71
	M/E	11
School Language	Me	47
	Em	6
	M/E	29

2.2 Research design

This research employed a mixed quantitative and qualitative design to allow thorough explanations (Creswell & Plano Clark, 2011). The qualitative part of this study involved spelling patterns analysis while the quantitative design investigated the relationships between the dependent (word and non-word spelling scores and time-taken) and independent variables (gender, grade, school-type, school-language, home-language) and comparison of spelling patterns among the independent variables.

2.3 Research tools

Three research tools were utilized in this study; a standardized Maltese spelling test, a researcher-designed non-word spelling test and a language questionnaire. The Maltese word spelling test forms part of the standardized TORPAM (Aguis, 2012) and has 60 test items divided into groups of 20 test-items corresponding to each of grade 4, 5 and 6.

For the aim of this study, a non-word spelling test that paralleled the content of the Maltese Spelling Test was developed (Agius, 2012). Non-words had the same length as the corresponding real words; however auditory similarity between real words and non-words was avoided. For example the real word *kelb* (dog) corresponded to the non-word *nejġ*. The inclusion of the graphemes *gh* and *h* in non-words was optional since these are silent in Maltese words except in word-final position. Therefore, participants could map phoneme to graphemes directly. The questionnaire

disseminated in Maltese and English (Xuereb, 2009) aimed to investigate the language use in home and school settings.

2.3.1 Administration

Tests were administered in a quiet room at the participants' schools. The questionnaires were completed individually with the participants.

2.4 Data coding and analysis

Every collected score sheet was assigned a number and a code to indicate gender, school-type and grade of the participant. The time taken to complete the test was recorded. The classroom and home language variables were determined from the questionnaire responses. The acronym Me was attributed if Maltese was chosen, M/E was assigned if both Maltese and English were chosen. Em (mostly English) was assigned if participants chose it in school-spoken language. The spelling patterns/errors in each word were analyzed. Notarnicola et al. (2012) analysed and classified spelling patterns/errors to study the DRM route in Italian. A classification system was also developed for this study taking into consideration Maltese orthography and spelling patterns that emerged in other studies described in Section 1. The different types of spelling patterns were also counted. Quantitative analysis was conducted using the IBM SPSS Statistics Version 22 software.

Table 2. Comparison of mean scores and time-taken (grouped by grade)

Subtest	Grade	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		p-value
					Lower Bound	Upper Bound	
Non-word spelling	Grade 4	34.46	13.08	2.56	29.18	39.74	0.026
	Grade 5	41.15	9.34	1.80	37.45	44.84	
	Grade 6	42.59	11.81	2.19	38.09	47.08	
Non-word spelling time taken	Grade 4	854.04	201.94	39.60	772.5	935.60	0.000 ^a
	Grade 5	714.04	77.33	14.88	683.45	744.63	
	Grade 6	587.21	117.65	21.85	542.46	631.96	
Word spelling	Grade 4	42.35	14.80	2.90	36.37	48.33	0.000
	Grade 5	56.15	8.93	1.72	52.62	59.68	
	Grade 6	60.48	10.77	2.00	56.39	64.58	
Word spelling time taken	Grade 4	1132.00	180.99	35.50	1058.90	1205.10	0.000 ^b
	Grade 5	777.85	121.60	23.40	729.75	825.96	
	Grade 6	670.62	76.892	14.28	641.37	699.87	

^ap-value generated by Kruskal-Wallis

^bp-value generated by Kruskal-Wallis

3 Results

Shapiro-Wilk normality test was conducted and to exercise caution, parametric tests (one-way ANOVA) were conducted with non-word spelling scores and the equivalent non-parametric test (Kruskal-Wallis H Test) was conducted with the atypically distributed samples.

Children obtained a higher mean score in word spelling (53.30) than non-word spelling (39.54). One-way ANOVA was used to compare mean word and non-word spelling scores and time-taken between the independent variables. Differences in time-taken to complete both the word and non-word spelling tests, among children who either speak Me, M/E, Em in the school setting were statistically significant because $p < 0.05$ (Table 3).

Grade 6 participants obtained higher mean scores in non-word spelling (42.59) than grade 5 (41.5) and grade 4 participants (34.46). The same pattern was observed in word spelling scores. Grade 4 students spent more time in non-word (854.04) and word spelling (1132.00) than grade 5 and 6 participants. Grade 6 participants spent the least time to complete the non-word spelling (587.21) and word spelling test (670.62). These differences in word and non-word spelling mean scores and time-taken were statistically significant because $p < 0.05$ (Table 2).

In addition to descriptive statistics, an analysis of spelling patterns was carried out. The tables below illustrate the spelling patterns that emerged in the administration of the Maltese Spelling Test (Aguis, 2012) (Table 5) and the non-word spelling test (Table 4).

Table 3. Comparison of mean scores and time-taken (grouped by school-language)

Subtest	Classroom Language	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		p-value
					Lower Bound	Upper Bound	
Non-word spelling	Mostly Maltese	39.36	11.34	1.66	36.03	42.69	0.839
	Mostly English	42.33	10.52	4.30	31.29	53.37	
	Maltese-English	39.24	13.28	2.47	34.19	44.29	
Non-word spelling time taken	Mostly Maltese	668.19	143.54	20.94	626.05	710.34	0.016a
	Mostly English	636.50	23.53	9.61	611.81	661.19	
	Maltese-English	803.07	209.03	38.815	723.56	882.58	
Word spelling	Mostly Maltese	54.96	13.28	1.94	51.06	58.86	0.432b
	Mostly English	55.17	7.055	2.88	47.76	62.57	
	Maltese-English	50.24	15.64	2.90	44.29	56.19	
Word spelling time taken	Mostly Maltese	814.40	239.87	34.99	743.98	884.83	0.033c
	Mostly English	779.00	217.34	88.73	550.92	1007.08	
	Maltese-English	928.66	220.24	40.90	844.88	1012.43	

^ap-value generated by Kruskal-Wallis

^bp-value generated by Kruskal-Wallis

^cp-value generated by Kruskal-Wallis

Table 4. Spelling patterns in Maltese non-word spelling

Spelling Pattern	Description	Example(s)
Spelling Patterns associated with the Lexical Route		
Orthographic Patterns • Patterns involving the <i>gh</i> and <i>h</i> • Additions of <i>gh</i> and <i>h</i> • Substitutions of <i>gh</i> and <i>h</i>	Patterns that involve the special Maltese graphemes <i>gh</i> and <i>h</i> .	<i>Nejġ - ngheġ</i> <i>Shul - sghul</i> <i>Għakx - qakx</i>
Phonetic Patterns	All the sounds in the word are present but spelled incorrectly.	<i>Died - diet</i>
Spelling Patterns indicating Sub-Lexical Route Failure		
Consonants: • Omissions • Substitutions • Additions	These errors involve consonants, including incorrect omissions, substitutions and additions.	<i>Nejġ - ngheġ</i> <i>Died - diet</i> <i>Rehba - qreba</i>
Vowels: • Omissions • Substitutions • Additions	These errors involve vowels, including incorrect omissions, substitutions and additions.	<i>Doppiwiet - doppiwet</i> <i>Vienel - vemel</i> <i>Knaqqarhulu - knaugarulu</i>
Metathesis	Switching the position of letters in a word.	<i>Qtieq - qiet</i>
Second Language Influence	Influences from other languages, mainly English. May include the use of foreign letters and orthography.	<i>Għakx - ghaksh</i> <i>Fapliki - phapliki</i>
Syllables: • Omissions • Additions	These errors involve syllables, and include deletions and additions of syllables.	<i>Kaffiċċieri - kaf</i> <i>Qtieq - buqtieq</i>
Geminate Reduction	Reducing two identical consonants (geminate pair) to one constituent consonant.	<i>Dalla - dala</i>
Duplication	Duplicating one consonant to form a geminate pair.	<i>Shul - sull</i>
Vowel Reduction	Reducing the long vowel [ie] to the short vowel [i].	<i>Ptieq - ptit</i>
Vowel Lengthening	Replacing the Maltese short vowel [i] with the long vowel [ie].	<i>Likar - liekar</i>
Spelling Patterns involving Morphological Components		
Morphological Patterns: • Omissions • Additions	These patterns include the spurious additions of morphemes and failure to recognize and include morphemes.	<i>L-(gh)axx - lash</i> <i>Kalloggħa - K'alloggħa</i>
Word Assimilation Errors (Campbell, 1983)		
Word Assimilation Errors	Writing the real word that resembles the non-word.	<i>Takiblar - katiedral</i>
Other Errors		
Errors involving Maltese Orthographic Conventions	This involves spelling errors of Maltese spelling conventions such as marking consonantal voicing in [ġ].	<i>Happus - happus</i>
Unrecognizable	Production of an unrelated word that does not resemble the stimulus item.	<i>Mintasadlek - dmatli</i>

Table 5. Spelling patterns in Maltese word spelling (Aguis, 2012)

Spelling Pattern	Description	Example(s)
Lexical Route Errors (Phonologically Plausible Errors)		
Orthographic Errors • Errors involving <i>gh</i> and <i>h</i> • Omission of <i>gh</i> and <i>h</i> • Substitution of <i>gh</i> and <i>h</i>	This group entails spelling errors involving the Maltese graphemes <i>gh</i> and <i>h</i> . These spelling patterns include substitutions and omissions of these graphemes.	<i>Lehġa</i> - <i>leghġa</i> <i>Lehġa</i> - <i>leġa</i> <i>Għanqbuta</i> (<i>web</i>)- <i>qabuta</i>
Phonetic Errors	Phonetic errors occur when all the sounds in the word are present but spelled incorrectly.	<i>Mewġ</i> (<i>waves</i>)- <i>mewċ</i> <i>Għatx</i> (<i>thirst</i>)- <i>ghaċ</i> ¹ <i>Nergħu</i> (<i>repeat</i>)- <i>nergaw</i>
Morphological Errors		
Spurious Additions of Morphemes	Incorrect inclusions of morphemes, for example articles and affixes, in a word.	<i>Qtigh</i> (<i>cuts</i>)- <i>it-tieħ</i>
Omissions of Morphemes	The elimination of morphemes, including articles and affixes in a word.	<i>Minnha</i> (<i>from her</i>)- <i>minna</i> <i>l- għažż</i> - <i>lghaž</i>
Sub-Lexical Route Errors		
Consonants: • Omissions • Substitutions • Additions	This group includes spelling errors of consonants, including incorrect omissions, substitutions and additions.	<i>Qaqoċċa</i> (<i>artichoke</i>)- <i>aoka</i> <i>Qaqoċċa</i> - <i>aoka</i> <i>l- għažż</i> (<i>laziness</i>)- <i>blažż</i>
Vowels: • Omissions • Substitutions • Additions	This group includes spelling errors of vowels, including incorrect omissions, substitutions and additions.	<i>Xoġhol</i> (<i>work</i>)- <i>xoġhl</i> <i>Tmaqdarhulu</i> (<i>she finds fault</i>)- <i>tmaqdurhu</i> <i>Qawwija</i> (<i>strong</i>)- <i>awijia</i>
Metathesis	This involves switching the position of vowels and consonants in a word.	<i>Kavaliġeri</i> (<i>knight</i>)- <i>kalaviri</i>
Second Language Influence	This includes influences from other languages, mainly English, in a word. This may involve the use of foreign letters and orthography.	<i>Skola</i> (<i>skola</i>)- <i>schoola</i>
Duplication	Duplicating an identical consonant/vowel.	<i>Qawwija</i> (<i>strong</i>)- <i>qawwijia</i>
Geminate Reduction	Reducing two identical consonants (geminate pair) to one constituent consonant only.	<i>Bajja</i> (<i>beach</i>)- <i>baja</i>
Vowel Reduction	Reducing the long vowel [<i>ie</i>] to the short vowel [<i>i</i>].	<i>Bottijiet</i> (<i>cans</i>)- <i>bottijit</i>
Vowel Lengthening	Replacing the Maltese short vowel [<i>i</i>] with the long vowel [<i>ie</i>].	<i>Qtigh</i> (<i>cuts</i>)- <i>qtiegh</i>
Syllables: • Omissions • Additions	This group includes spelling errors involving syllables, such as syllable omissions and additions.	<i>Nitkexkex</i> (<i>I feel goosebumps</i>)- <i>nitkex</i> <i>Gżejjer</i> (<i>islands</i>)- <i>ingzejjer</i>
Other Errors		
Omissions of Orthographic Conventions	This involves spelling errors of Maltese spelling conventions such as marking consonantal voicing in [<i>g</i>].	<i>Xoġhol</i> (<i>work</i>)- <i>xoghol</i>

¹These two spelling errors can be classified as both lexical and sub-lexical errors because children require both a phoneme-grapheme correspondence approach (sub-lexical) and a whole-word approach (lexical) in order to apply the final devoicing rule.

The frequency of spelling patterns was also counted. Figure 1 illustrates the mean percentage occurrence of spelling patterns in the Maltese word spelling test. Geminate reduction was the most frequent spelling pattern in word spelling, while syllable additions were the least frequent.

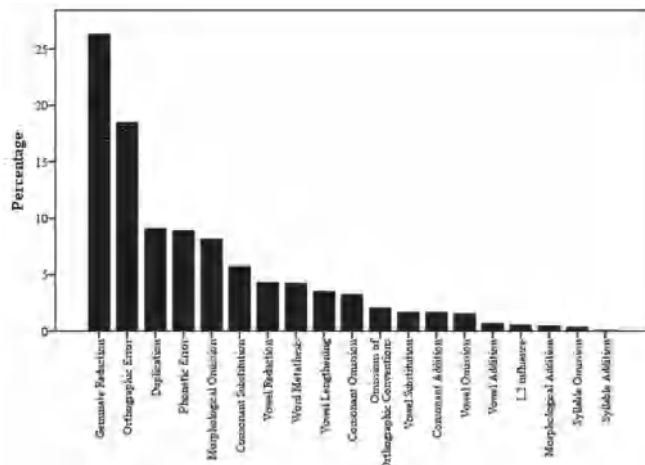


Figure 1. Spelling patterns in the Maltese word spelling (Agius, 2012)

Figure 2 illustrates the occurrences of spelling patterns in Maltese non-word spelling. Consonant substitutions were the most frequent spelling pattern while syllable additions were the least frequent spelling patterns observed in non-word spelling.

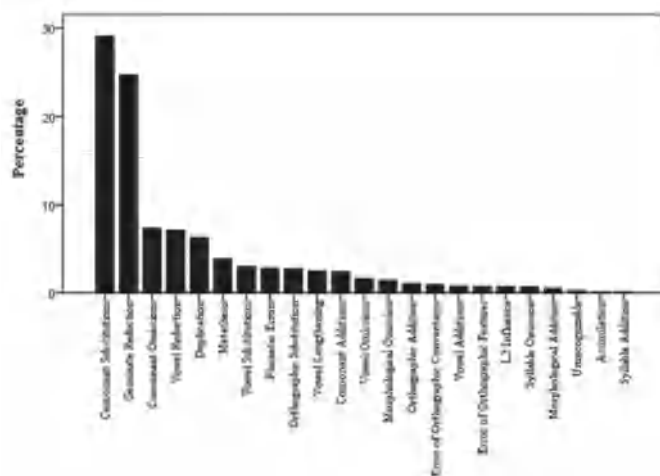


Figure 2. Frequency of spelling patterns observed in non-word spelling

4 Discussion

4.1 Performance in Maltese word and non-word spelling

Findings indicate that word and non-word spelling scores are significantly affected by grade. The time-taken to complete both tests is significantly affected by grade and school-

language. Children in grade 6 obtained better word and non-word spelling scores than grade 4 students. Agius (2012) also found that grade 6 students performed better than younger students in Maltese word spelling. Older students obtained better scores possibly because they have been exposed to the curriculum more than the younger cohort.

In all grades, children were more accurate in word spelling than non-word spelling. This may be explained in terms of a lexicality effect which was also reported by Notarnicola et al. (2012). This means that children tended to perform better in word spelling than non-word spelling. Sprenger-Charolles, Siegel, Bechennes and Serniclaes (2003) and Notarnicola et al. (2012) found that a ceiling effect in non-word spelling was present by the third grade. This ceiling effect is reached because sub-lexical approaches (supposedly used to spell non-words) develop early (Notarnicola et al., 2012). This study did not find a ceiling effect, which may indicate that children are using both lexical (supposedly utilized in spelling irregular words) and sub-lexical routes in the two spelling tests. Agius (2012) confirmed that both routes are applied in Maltese word spelling. Another possibility is that the newly developed non-word test was difficult for all the three grades.

Children in all three grades were faster to complete the non-word spelling test than the word-spelling test. Zevin and Seidenberg (2006) maintained that latency effects (time-taken) are produced by words with irregular grapheme-phoneme correspondences, which produce conflicts between the lexical and sub-lexical routes. The word-spelling test includes words with both regular and irregular phoneme-grapheme correspondences (because these contain digraph/graphemes *gh* and *h*). These graphemes could be omitted in the non-word spelling test. This finding indicates that irregular test-items in the word-spelling test may contribute to longer latencies.

The performance of school-language Maltese-dominant and Maltese-English bilingual participants in the word and non-word spelling tests was studied. School-language refers to the language spoken at school which is used for different purposes than home-language (Schleppegrell, 2004) and may eventually influence home language (Wang, 2008). Like Agius' (2012) findings, this study did not find statistically significant differences in word spelling scores. Post-hoc results revealed a significant difference between the bilingual and Maltese-dominant groups in the time-taken to complete the non-word spelling test only ($p = 0.003$). The bilingual group were slower to complete the non-word test. Agius (2012) explained that bilinguals possess and retrieve knowledge of two different codes (Maltese and English) and therefore require more time. De Sousa et al. (2011) also argued that bilinguals have busier cognitive loads because they are learning two languages. In this study, all participants were learning literacy in both languages but spelling was assessed in Maltese only. The distinction between the Maltese and English dominant and bilinguals' time-taken may be related to the effects of learning both L1 and L2 spelling and the busier cognitive loads that bilingual students have. Similar to Agius, the researcher did not find statistically significant differences in state and church schools' scores.

4.2 What spelling patterns associated with sub-lexical and lexical processing in the dual-route model? What do these spelling patterns indicate about the participants' knowledge of Maltese orthography?

Spelling patterns in the Maltese word-spelling test were grouped into four distinctive categories. The first category was characterized by *lexical route failure*. The first group in this category involved the Maltese special orthographic features, the *gh* and *h*. These spelling patterns indicate *lexical route failure* because this route accesses phonological memory representations and word-specific orthographic features in spelling. The sub-lexical route, which activates sound-spelling correspondences (Rapsak, Henry, & Beeson, 2007), cannot be utilized in spelling words involving these graphemes because *gh* and *h* are silent except in word final positions (Hoberman, 2007). Notarnicola et al. (2012) also classified ambiguous spellings under this category in Italian. When the sub-lexical route was utilized to spell ambiguous words (words dependent on context-sensitive rules and have indirect phoneme-grapheme correspondences), phonologically plausible errors were produced. This implies that the produced words still possessed correct phoneme-to-grapheme conversions (indicating sub-lexical processing) but the letters are incorrect therefore indicating lexical route failure. De Sousa et al. (2011) also analyzed spelling patterns in English and argued that since English has an irregular phoneme-to-grapheme correspondence; lexical spelling would need to be utilized.

Spelling patterns involving *gh* and *h* resulted in confusions, for example *lehġa* was written as *legħġa*. Omissions and substitutions were also present, for example *għanqbuta* (*web*) was written as *qanqbuta*. In these instances, participants produced phonologically plausible errors and this is evidence of lexical route failure. The occurrence of these spelling errors was only significant when grade was factored in ($p = 0.14$). Post-hoc analysis revealed that 5th graders presented these spelling patterns more than the other grades did. This shows that this particular cohort continued to experience difficulties with these graphemes until later grades and may be the result of new rules introduced in this grade having a negative impact. Agius (2012) also found that as a result of difficulties with *gh* and *h*, Maltese students' spelling abilities are low in the grade 4 to 6 student population.

The second category associated with lexical route failure is called *phonetic errors*. According to Goulandris (2003) phonetic spelling occurs when the correct sounds in a word are denoted with the incorrect use of letters (e.g. *cool*-cule). Maltese makes a distinction between automatic phonological processes like final consonant devoicing and their representations in orthography. For example, the word *ħobż* (*bread*), which orthographically ends with the voiced consonant *ż*, ends with the unvoiced consonant /ħops/ when pronounced. This phenomenon was a source of spelling errors because participants spelled the word phonologically (used the unvoiced consonant). A technique can be used, in which spellers derive a related word to determine if the

last consonant is voiced or unvoiced (A. Borg, personal communication, February 14, 2014), to avoid these spelling patterns. This study did not obtain information about whether these techniques are taught in the curriculum to facilitate Maltese spelling. A statistically significant difference in the occurrences of phonetic errors was not found.

The third category of spelling errors involved *omissions and additions of morphemes*. Potopapas et al. (2013) found evidence of morphological errors in Greek. These spelling patterns were expected because Maltese has a productive morphology, meaning that the predominantly Arabic morphology can be attached to any word of Romance and English origin (Hoberman & Aronoff, 2003). A morphological spelling pattern was seen with the word *l-ġħazz* (*the laziness*). The article was frequently omitted from this word. The article, *l-*, expresses definiteness in Maltese (Borg & Azzopardi-Alexander, 1997). The researcher found statistical significance for morphological omissions when comparing these among the three grades only ($p = 0.006$). Grade 5 students presented morphological omissions more commonly than the other grades. Lehtonen and Bryant (2005) argued that spellers must understand spelling rules based on morphology since following phoneme-grapheme correspondences is not enough. This study found that Maltese participants continued to experience difficulties with morphological representations in later years.

The third category of spelling patterns included spelling patterns characterizing sub-lexical route failure. This means that spelling patterns occurred as a result of incorrect phoneme grapheme correspondences (Houghton & Zorzi, 2003), giving rise to consonant, vowel and syllable omissions, additions and substitutions, metathesis, L2 influences, duplications and geminate reductions, vowel lengthening and reductions. Notarnicola et al. (2012) argued that development of the sub-lexical route should occur earlier on. In fact, stage theories (e.g. Gentry, 1982; Ehri, 1986) of development included phoneme-grapheme conversion in their theories. Difference in occurrences was only found for vowel reduction ($p = 0.004$), consonant omissions ($p = 0.001$) and L2 influences ($p = 0.20$) across grades.

Grade 4 participants presented more spelling patterns influenced by English (the L2 in Malta). For example *skola* (*school*) was written as *schoola* and *fabbriki* (*factories*) was written as *phabbriki*. Spelling patterns that indicate L2 influences are evidence of sub-lexical failure because Maltese graphemes are written with their IPA value. Therefore, L2 influences indicate failure to use direct phoneme-grapheme conversion. These findings indicate that although sub-lexical route use in spelling should occur earlier in development (Notarnicola et al., 2012), Maltese students continue to present sub-lexical route failure due to L2 influences by the end of primary school even though English literacy is introduced early in Grade 1 in Malta (Ministry for Education and Employment, 2014). The last category of spelling patterns is termed *others*. This category involved Maltese orthographic conventions, for example omitting indications of voiced consonants (for example, the *dot* marking voicing in *ġ* and *ż*). Occurrences of these spelling patterns were not statistically significant.

4.3 Spelling patterns in non-word spelling

Bates et al. (2007) claimed that non-words and words with direct sound-letter correspondences activate the sub-lexical route. However, Tainturier & Rapp (2001) claimed that both lexical and sub-lexical routes interact in spelling. A non-word spelling test can be utilized to assess the sub-lexical route because knowledge of sound-letter conversions is necessary. Despite this, spelling non-words is not exclusively associated with the sub-lexical route. For example, Campbell (1983) found that non-words spellings were compared to real word prime words. This indicates that spellers may model non-word spellings on real word spelling.

The first category of non-word spelling patterns involved additions and substitutions of the Maltese graphemes, *gh* and *h*. These graphemes were marked as optional in the non-word spelling test and participants were not penalized if they did not include them. Spelling patterns were only counted if the wrong grapheme was used or substituted with a consonant. Substitutions of these graphemes in non-words were statistically significant across grades ($p = .10$). Grade 5 students frequently substituted these graphemes with other consonants. This finding shows that participants cannot represent these graphemes consistently in non-word spelling. Spelling patterns involving additions of these graphemes were interesting. For example, the grapheme *gh* was often added to the test-item *nejġ*. The grapheme *gh* can lengthen adjacent vowels (Hoberman, 2007) and this example may indicate that participants compared non-word test-items to real words. In fact, during administration participants could identify the real word that the non-word was based on. This shows that like Campbell's (1983), and Martin and Barry's (2012) research some degree of priming may have occurred.

Another class of spelling patterns in non-word spelling was referred to as *phonetic errors*. These patterns were highly associated with the final consonant devoicing process in Maltese. Therefore, non-words that ended with a voiced consonant were represented orthographically with the unvoiced consonant. For example, the non-word *ġlaled* was written *ġlalet*. The pronunciation of the word itself could not avoid this phonological process and therefore participants used the sub-lexical route to spell these words. This may indicate that participants did not acknowledge this distinction between Maltese phonology and orthography. Such instances were considered as a spelling pattern in this research, however non-word spelling should reflect direct sound-to-letter correspondences and should be more flexible in allowing the participants' interpretation of the language's orthography. This will be considered in future studies. This spelling pattern was not statistically significant.

The majority of spelling patterns in non-word spelling exhibited *sub-lexical route failure*. This gave rise to consonant, vowel, and syllables omissions, additions and substitutions, metathesis and L2 influences, vowel lengthening and reduction, geminate reduction and duplication. There were no statistically significant differences in the occurrences of these spelling patterns among all the independent variables. Nonetheless, these patterns were characterized as sub-lexical route failure because they exhibited incorrect phoneme to

grapheme conversions. Stage theories of development and Notarnicola et al. (2012) claim that sub-lexical processing should occur earlier on in spelling development. In contrast, these findings indicate that with regards to this specific population, Maltese students continue to experience difficulties with phoneme-to-grapheme correspondences.

The third category involved *morphological components*. Differences in the occurrences of morphological components were statistically significant across the three grades ($p = 0.006$). The non-word spelling test involved the use of articles, which were often not recognized by the participants. These spelling patterns are not necessarily incorrect because these reflect sound to letter conversions of the participants (sub-lexical processing). Nonetheless, Lehtonen and Bryant (2005) found that beginner Finnish spellers parsed segments that represented morphemes in non-words and did not interpret non-words as a whole. Participants also added morphemes to non-words in this study, in particular articles and clitics for example *kalloġġa* was written as *k'alloġġa*. The prepositions *fi* (in) and *bi* (with) can cliticize to a noun (Borg & Azzopardi-Alexander, 1997). This example in the non-word spelling test is similar to this Maltese occurrence although the clitic *k'* does not exist. However, this may indicate that participants are modelling non-word spellings to real words and morphological components (real word priming). This occurrence was not statistically significant. The last class of spelling patterns involved assimilation of non-words to real words, failure to recognize orthographic conventions and other unrecognizable errors. Non-word assimilation indicates comparisons to real words (Campbell, 1983). Unrecognizable patterns are equivalent to Snowling's (1987) *non-phonetic errors*.

5 Conclusion

Maltese word and non-word spelling skills of children attending state and church schools are significantly affected by grade. School language was found to significantly affect spelling rate. This research also uncovered a lexicality effect, in which word spelling scores are better than non-word spelling scores. All grades (grades 4 to 6) also experienced notable difficulties with sub-lexical phoneme-grapheme conversions and *gh* and *h*. Statistical significance was particularly marked for grade 5 students. Moreover, Maltese word spelling patterns can be classified under four distinctive categories, indicating lexical and sub-lexical routes failure, difficulties with morphological components and other errors related to Maltese orthography. An additional category, *assimilation*, was found in non-word spelling.

Limitations to this study include the omission of the third school type in Malta, independent schools, because this school type tends to emphasize spoken English. This research was interested in the assessment of monolingual Maltese (Me) and bilingual Maltese-English children (M/E), therefore independent school children were not included. Research findings therefore can only be generalized to this specific population. The non-word spelling test generated a low Cronbach's alpha, which may indicate inconsistency in deriving the same scores.

This research is the first of its kind to explore processes in Maltese students' word and non-word spelling in relation to their spoken language. The study's findings can inform practitioners such as language teachers and Speech-Language Pathologists about students' typical and atypical spelling patterns, knowledge of sound-letter conversions and processing time. Future research aims to address permissible non-word spelling patterns that reflect students' phoneme-grapheme conversions and to increase the reliability of the non-word spelling test. This research would include and compare English and Maltese word and non-word spelling abilities to investigate transfer effects and error types in both languages.

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8 Conflicts of interest

The authors report no conflicts of interest.

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Footnotes

- 1 These two spelling errors can be classified as both lexical and sub-lexical errors because children require both a phoneme-grapheme correspondence approach (sub-lexical) and a whole-word approach (lexical) in order to apply the final devoicing rule.

Commentary

ENHANCING HEALTHCARE VIA AFFECTIVE COMPUTING

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Abstract. Affective computing is a multidisciplinary field that studies the various ways by which computational processes are able to elicit, sense, and detect manifestations of human emotion. While the methods and technology delivered by affective computing have demonstrated very promising results across several domains, their adoption by healthcare is still at its initial stages. With that aim in mind, this commentary paper introduces affective computing to the readership of the journal and praises for the benefits of affect-enabled systems for prognostic, diagnostic and therapeutic purposes.

Keywords: affective computing, healthcare, emotion elicitation, emotion modelling, emotion detection

1 Introduction

Emotion can be defined as a conscious experience which is characterized by intense mental activity and varying degrees of pleasure or displeasure. The study of emotions and their links to mental and physical health is foundational to science (Hett, 1936). Given its importance to our very existence, emotion has been studied from a multitude of disciplines including social psychology, marketing, philosophy, neuroscience, and artificial intelligence. A relatively recent field at the crossroads of computer science, psychology and physiology, named affective computing (AC) (Picard, 1997), has shed some light on the relationship between the feeling of an emotion (i.e., affect) and its corresponding responses. In that regard, AC can be defined as the computational study of emotion and its manifestations through systems that enable a form of interaction between humans and computers.

Over the last two decades AC has experienced advancements that gradually grew the field to become an influential area for research and industrial development (Calvo et al., 2015). Nowadays software is able to detect human emotions with a supreme accuracy under particular conditions; hardware can sense manifestations of our physiology, our speech and

body motion and infer reliably in what emotional state we are currently in (Calvo et al., 2015).

While the benefits of AC are directly applicable to many health disciplines no study in the literature gives a comprehensive overview of what AC can offer to healthcare at large. Motivated by this lack of general overview, this paper takes a quick glance over the opportunities arising from the adoption of AC by healthcare. The paper introduces the various methods through which emotion can be recognized computationally and communicated to healthcare stakeholders including patients, doctors, healthcare educators, or medical administrators. As evidenced by the numerous studies referenced in this paper, this continuous dialog between health professionals and affect-based interactive systems can enhance directly the quality of both physical and mental healthcare services.

2 Affect Annotation

A fundamental challenge in AC is the labelling (or measurement) of emotions. The current dominant approach in AC is to represent emotions as interval values using the dimensions of arousal (or emotion intensity) and valence (or pleasantness) (Russell, 1980) and ask subjects to annotate arousal/valence values via continuous annotations (Cowie et al., 2000, Lopes et al., 2017). Alternative labelling methods include questionnaires that ask users to label particular categories of emotions (e.g., ‘happiness’), or assign a value in a Likert scale. It is important to note, however, that a plethora of recent studies in affect annotation (Holmgard, et al., 2015, Martinez et al., 2014, Tognetti et al., 2010, Yannakakis & Hallam, 2011, Yannakakis et al., 2017, Yannakakis & Martinez, 2015a, Yannakakis & Martinez, 2015b) have shown the supremacy of ordinal (rank-based) emotion annotation schemes over interval and nominal types of annotation in yielding affect models of higher accuracy, reliability and generality.

3 Affective Computing: The Core Elements

Emotions can generally be elicited via stimuli offered during the interaction with the affective system. The elicitation of emotions naturally leads to bodily manifestations that can

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then be detected and modelled by assessing the responses of the user to the corresponding stimuli. Those models can in turn influence the way the affective systems respond. In the remainder of this section we cover the four basic sequential key phases that comprise a closed-loop fully realised affect enabled software named affective loop (Sundstrom, 2005).

3.1 Affect Elicitation

In the first phase the user expresses her emotions during the interaction. Broadly speaking emotion can be elicited via pictures, videos, sounds, or games. These elements (elicitors) in the domain of healthcare may include social interaction with other patients, particular visuals and sounds associated with traumatic experiences, bodily stance of avatars during a virtual therapy session, a virtual environment that simulates a rehabilitation exercise, etc.

3.2 Affect Sensing

In the second phase the system detects the emotional reactions of the user, since emotion is manifested via bodily or physiological re-actions. These reactions can be captured via a camera, a gaze tracker, a microphone, or a multitude of physiological sensors (Sharma & Gedeon, 2012) such as electrocardiography (Yannakakis et al., 2010), galvanic skin response (Holmgard et al., 2015, Holmgard et al., 2013, Mandryk et al., 2006), respiration (Tognetti et al., 2010), and EEG (Nijholt, 2009).

3.3 Affect Modelling

Once manifestations are captured via sensor technology and labels of affect are available the next step is to derive the mapping (i.e., the model) between user affect and her bodily or physiological manifestations. The core steps involved in this process (Calvo & D'Mello, 2010) include signal processing, feature extraction, and machine learning which are outlined here. In signal processing we are faced with time-series data (e.g., a skin conductance signal) that we need to remove noise from; noise in the data is usually caused by hardware limitations. Feature extraction refers to the process of designing appropriate data attributes from processing (e.g., average skin conductance). Note that important interaction events (e.g., the avatar smiled to the patient) should normally be used to determine the time window that features can be extracted from (Holmgard et al., 2015, Kivikangas et al., 2010, Ravaja et al., 2006). Modern machine learning approaches such as sequence mining (Martinez & Yannakakis, 2011)—i.e., statistical methods that identify frequently co-occurring events—and deep learning (Martinez et al., 2013)—i.e., multi-layered non-linear artificial neural networks—have given very promising results. In certain cases, the models are able to predict affective states with more than 90% accuracy.

If labelled data comes as an interval (e.g., today is 85% painful) or nominal (e.g., today is painful) value any regression or classification algorithm can be used to build affective

models. If instead labelled data is given in a rank format (e.g., today is more painful than yesterday) the problem becomes one of preference learning which involves statistical methods that rank lists or pairs of options (Furnkranz & Hullermeier, 2005, Yannakakis, 2009).

3.4 Affect-driven Adaptation

For the affective loop to be closed the affect-enabled software needs to be able to adapt to the current state of the user. Within the healthcare domain, one can envisage optimizing the behaviour of a virtual character or altering the environment (digital content) for minimizing pain, physical fatigue while at the same time maximizing engagement or even empathy towards a virtual character (Leite et al., 2010). The digital content may include every aspect of the environment the patient is interacting with such as lighting, visuals, stories, sound effects and music. An alternative way to adapt to a user's emotion is via virtual characters; these characters may act believably as their actions may be determined by emotional reactions to events. Popular examples of believable virtual character models include the EMA (Gratch & Marsella, 2004), the FAtiMA (Lim et al., 2012) and the ALMA (Gebhard, 2005) models.

4 Healthcare Applications of Affective Computing

From a computational perspective, healthcare is not any different than any other domain in which AC has delivered successful and robust solutions. In that regard, all methods introduced by AC can aid the development of better affect-aware health technologies. Some of the most popular uses of affect-enabled systems are summarized below.

Autism: A popular application of affective systems to health is related to syndromes or developmental disorders such as Autism characterized by limitations on social interactions and on processing or expressing emotions. In particular, the primary focus has been on the assistance of parents, teachers and carers of children with autism (Kaliouby et al., 2006, Liu et al., 2008, Picard, 2009). These tools detect the affective state of children and communicate it to themselves or others, thereby enhancing communication and assisting social interaction.

Stress and anxiety: A significant part of the world's population is affected by depression, stress and anxiety-related disorders, which are interdependent and directly connected to emotion (World Health Organization, 2018). Affective systems have successfully been used as mental health interventions or as diagnostic and treatment tools for depression and numerous anxiety-related disorders. One popular such use is for the diagnosis and treatment of post-traumatic stress disorder (PTSD), which is developed after a person is exposed to a traumatic event, such as warfare. Among the possible ways of treating PTSD, computer games and virtual environments have a particular potential for eliciting stress in a controlled, graded fashion and can provide an immersive medium for stress management (Holmes et al.,

2009, Rizzo et al., 2009, Wiederhold & Wiederhold, 1998). Virtual reality (VR) therapy can be viewed as an extension of exposure therapy (an anxiety disorder technique that exposes the target patient to the anxiety source) as it can expose the patient to the original stressful, traumatizing situation; notable examples of that approach are the Virtual Iraq and Virtual Afghanistan applications (Reger et al., 2011, Rizzo et al., 2009). Other implementations have focused on appropriating principles from stress inoculation training—a type of therapy that blends cognitive and behavioural training techniques to target the stressors of a patient (Wiederhold & Wiederhold, 2008)—or even hybrids of exposure therapy and stress inoculation training (Holmgard et al., 2015, Holmgard et al., 2015a).

Physical health and rehabilitation: Beyond mental health applications, AC is directly applicable to physical healthcare tasks. A number of studies have focused on the use of tangible interactive systems that enhance the engagement of patients during a rehabilitation session (Yannakakis & Hallam, 2009). Emotion can be recognized through the body stance of the patient with the aim to relieve pain during an exercise (Newbold et al., 2016, Singh et al., 2014) or to increase engagement during interactive sessions with games (Dimovska et al., 2010, Hocine et al., 2015).

Call centres and tele-medicine: Applications of AC also expand to telemedicine (Kranzffelder et al., 2011, Pollak et al., 2007) as the very communication between the patient and the health practitioner is largely built on emotional traits and trust. Thus, detecting the affective state of the patient can assist the health practitioner to better understand the current emotional needs of the patient from a distance. In turn, this enhanced communication can improve the patient's satisfaction and lead to a more effective treatment (Lisetti et al., 2003). One common approach is to use virtual characters that are able to express emotion (Pasquariello & Pelachaud, 2002) and thus are capable of simulating patient-doctor dialogs or therapy sessions. Such characters have been shown to build the trust and therapeutic alliance which are necessary for a reliable healthcare practice (Lisetti et al., 2003).

5 Discussion and Conclusions

AC merges experimental approaches from psychology with methods derived from machine learning for the purpose of modelling emotion. This process comes with certain limitations: 1) given the subjective nature of emotions the very labels of affect are often of questionable validity, 2) methods used for eliciting emotion are often not natural (i.e., laboratory conditions), 3) hardware for capturing affect is often faulty due to the environment (e.g., light) or the subject (e.g., movement). Despite the limitations modern AC methods can capture approximates of human affect accurately and adapt to these predictions. Future promising avenues of research for AC include the reliable capture of social signals in groups of people and in natural setups away from the laboratory.

Healthcare is a natural application area for AC as the role of emotion is central to our health, both physical and mental.

This paper outlined the core elements of AC in the context of health, proposed a number of key application areas of AC in healthcare, and served as a quick guide to the benefits of affect-adaptive systems for the diagnosis and treatment of medical conditions, and for the improvement of health services such as call centres.

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7 Conflict of interest

The author reports no conflicts of interest.

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Commentary

THE DEVELOPMENT OF THE ENGLISH-MALTESE ASSESSMENT OF SPEED OF HANDWRITING (EMASH)

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Abstract. This commentary discusses the development of the *English-Maltese Assessment of Speed of Handwriting* (EMASH), a novel bilingual (English and Maltese) writing speed diagnostic assessment battery. The EMASH is an adaptation of the *Detailed Assessment of Speed of Handwriting* (DASH), a previously standardized English assessment battery developed by Barnett, Henderson, Scheib & Schulz, 2007 with the aim of identifying handwriting difficulties. Given the lack of evaluation instruments that measure writing speed performance that are standardized on the local population, or are in the mother tongue, this study sets out to realize the translation and adaptation of the DASH for the Maltese population. The DASH is not scientifically appropriate to administer and score on Maltese children since it is standardized on a UK population.

Keywords: handwriting speed, DASH, assessment battery, bilingual, writing disorders.

1 Introduction

The EMASH measures the handwriting speed of 14-15-year-old Maltese students and identifies students experiencing difficulties with writing speed, those who find writing difficult and students who are at risk of writing disorders (namely dysgraphia). The test can also guide professionals evaluate handwriting.

2 Research aims

The EMASH aims to: (1) develop a novel writing speed diagnostic assessment battery; (2) develop local norms on handwriting speed of 14-15-year-old Maltese students; (3) conduct measures of validity and reliability; (4) support the request for access arrangements in national exams.

3 Writing Speed tests

Three principal methods of assessing writing speed include copying (Stabach, 1915; Wallen, Bonney & Lennox, 1996), writing to dictation (Horne, Ferrier, Singleton & Read, 2011) and free writing (Allcock, 2001; Christensen, 2004).

Average speeds on copying tasks revealed a growth from 54 letters per minute (LPM) at age 8-9 to 133 LPM at age 17-18 (Wallen et al., 1996). Results of writing to dictation revealed that students aged 11-12 wrote at an average speed of 16 words per minute (WPM), which for this test was equivalent to a speed of 62 LPM (Horne et al., 2011).

In order for tests to simulate examination conditions, they need to include a free writing task. However, free writing places cognitive demands on the pupil, such as the generation and structuring of ideas (Berninger, 1994; Hayes & Flower, 1980). Hence average rates on free writing tasks tend to be significantly slower. Allcock (2001) found the median handwriting speed of 11-year-olds to be 13.9 WPM and that of 16-year-olds to be 16.9 WPM. Christensen (2004) reported the handwriting speed of 13 year old students, to be 8.5 WPM.

The assessment adapted for the purpose of this research, *Detailed Assessment of Speed of Handwriting* (DASH; Barnett, Henderson, Scheib & Schulz, 2007) is the only test of handwriting speed that offers an overview of the types of writing tasks children are expected to execute in an educational environment. The five subtests of the DASH were developed in the UK and standardized on a sample of students aged between 9-16 years. The tasks *Copy Fast*, *Copy Best* and *Free Writing* are timed. The *Copy Fast* and *Copy Best* subtests involve the copying of the pangram *The quick brown fox jumped over the lazy dog*. In the *Free Writing* task, the students are first given a spider diagram (with prompts such as *school, friends, holidays, pets* etc.) which is discussed for a minute. They are then required to write a paragraph about *My Life* in ten minutes. Pilot studies have revealed that this topic enables students to generate material easily without too much thought or effort (Barnett et al., 2007). The two subtests, *Alphabet Writing* and *Graphic speed*, are equally timed. Whereas the *Alphabet Writing* task assesses the fluency and quality of handwriting (Graham, Berninger, Abbott, Abbott & Whitaker, 1997), the *Graphic Speed* test measures perceptual motor competence (see Figure 1) which results from the interaction between sensory perception

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and motor actions in increasingly skillful behaviors (Frost, Wortham & Reifel, 2010).



Figure 1. The Graphic Speed subtest

4 Research questions

Given the lack of evaluation instruments based on criteria adequate for Maltese school age children that measure speed performance and observe aspects of legibility of writing, this study sets out to develop such a tool. It also aims to address the following research questions:

- How can the DASH be used to support or change current educational practices?
- How do Maltese 14-15-year-old students perform at both the Maltese and English tests of handwriting speed?
- Is the EMASH a valid and reliable tool to identify speed of writing difficulties in young adolescents?

5 Consent

Ethical approval was sought and obtained from the DASH authors, the Faculty Research Ethics Committee (FREC) and the University Research Ethics Committee (UREC) at the University of Malta; the Education Division; the Secretariat for Education; the college principals; the heads of schools and the participants' parents.

6 Modifications to test content and administration in the development of the EMASH

Four out of five DASH subtests were modified during the development of the EMASH. Eight modifications were made and are outlined in Table 1. An exact replica of the graphic speed test used in the DASH was used in the EMASH.

Table 1: Modifications to the DASH subtest names during the development of the EMASH

DASH	EMASH	
barnett et al (2007)	Research version	
	English	Maltese
Copy Best	Copy Neatly	Ikkopja Pulit
Copy Fast	Copy Quickly	Ikkopja Malajr
Alphabet Writing	Copy from the Board	Ikkopja mill-Bord
Free Writing	Free Writing	Kitba Kreattiva

The *Copy Best* and *Copy Fast* subtests were renamed *Copy Neatly* and *Copy Quickly* respectively as two different pangrams were used in the EMASH. The Maltese pangram created for

this research is *Kien liebes gozz Hwejjeġ u ċraret vera qodma u m'għażluhx fil-pront* (He was wearing a pile of very old clothes and cloths and was not chosen promptly). This was developed through consultations with relevant professionals (Mifsud, 2016). The new English pangram *A mad boxer shot a quick, gloved jab to the jaw of his dizzy opponent* was selected from the site 'Fun with Words' (n.d.) because it is composed of 54 letters, to equal the number of letters in the Maltese pangram. This would allow for parallel comparisons in data scoring.

Minor changes were also made to the test administration. In the *Copy Best* and *Copy Fast* subtest in the DASH, the pangrams are distributed to the students on strips of paper for collection at the end of the test. In the *Copy Quickly* and *Copy Neatly* subtests in the EMASH, the pangrams are printed on the test papers with lines below them for students to write on. This new form of test administration makes it easier for testers as they do not have to collect strips of paper at the end of the testing session. No changes were made to test administration involving the time mark. The DASH requires participants to insert a time mark (//) after the first minute in the pangram copying tasks, and every two minutes in the free writing task.

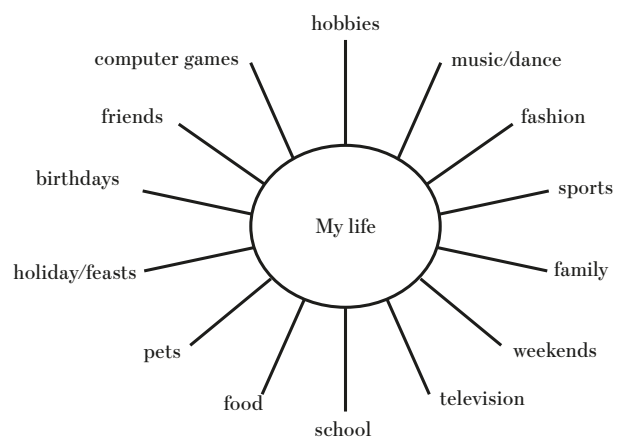


Figure 2. The spider diagram of the English free writing subtest of the EMASH

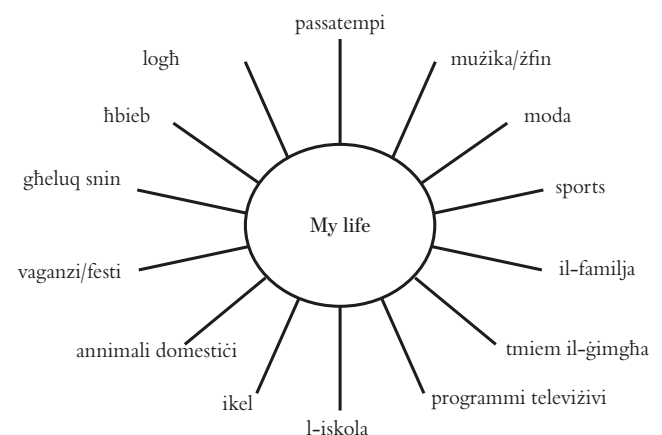


Figure 3. The spider diagram of the Maltese free writing subtest of the EMASH

Another modification made to the DASH was that of the *Alphabet Writing* task which was replaced by a *Copy from the Board* task. The latter task simulates copying from the white board during lessons, hence making the EMASH a useful diagnostic tool for classroom teachers. Students are required to copy the projected text as fast as possible, but legibly, as they would be asked to do in a classroom setting. The text chosen for the English subtests was taken from state annual past papers, pitched at track 3¹ of the Form 4 Syllabus, addressing Attainment Levels 4-6 (Education Division, 2007) (see Appendix A). The text chosen for the Maltese subtest was taken from the 2013 state Form 4 annual past paper, pitched at track 3 of the Form 4 Syllabus (Department of Curriculum Management, 2014-15) (see Appendix B). These texts were selected for two reasons. First, both texts are pitched at the level which students are expected to have reached at this stage, and therefore they should be familiar with the diction. Second, the texts do not have many punctuation marks (e.g. direct speech or question marks) making it less demanding for students to copy.

For the *Free Writing* task, in which participants are required to write about *My Life*, some of the prompts were changed to make them more culturally suitable. For example, 'feasts' was added to 'holiday' and 'clubs' was replaced with 'weekends'. The title of the Maltese free writing subtest was *Xi N'hobb Nagħmel (What I like to Do)* (see Figure 3) because it allows for the same prompts used in the English spider diagram (see Figure 2) to be used. This is so that testers may administer only one test version should they choose to do so.

The plan for the *Free Writing* task is presented in the DASH in the form of a spider diagram. Although the DASH presents a page large spider diagram, the EMASH presents a smaller spider diagram followed by lines, for practical purposes. This makes test administration more practical as the tester does not have to distribute the plan to each student, and collect it again afterwards, as is suggested in the DASH.

A sans serif font (Verdana), was used for the EMASH to avoid serif fonts that have hooks at the ends of the letters that tend to make letters run together, hence making reading more difficult for students with learning difficulties. The Verdana font was selected since a Matriculation and Secondary Education Certificate (MATSEC) study has shown that this font is viewed by students as the most readable font (MATSEC Support Unit, University of Malta, 2017).

7 Conclusion

This commentary discusses the development of a bilingual (English and Maltese) assessment of handwriting speed which was constructed to parallel a previously standardized UK assessment for the purpose of diagnosing writing difficulties in both educational and clinical contexts.

A pilot study concerning the viability of the EMASH was carried out in order to identify the challenges encountered by the participants and feedback from students and professionals, and to amend the tool and administration criteria accordingly. A cross sectional, quantitative research methodology was applied to the pilot study. About 20% of the sample of the total population of participants recruited for standardization was recruited for this study. Participants were stratified by age, ability and school type. They were secondary school students (age range 14 to 15 years) in Form 4 classes, attending state, church and independent schools. The ratio of the participants was 10 (state): 3 (church): 1 (independent). This reflects the Maltese student population attending state, church and independent schools. Participants were also selected by ability. An equal number of high ability, average and low ability students were selected based on their academic performance, with students who attained high grades at exams being classified as high ability students, and those who attained low grades as low ability students. Prior to the pilot study, domain-related experts including practitioners (such as occupational therapists and educational psychologists) and university lecturers, were invited to offer their professional feedback on face and content validity of the test questions in order to determine how relevant the test items were for the purpose intended. It is beyond the scope of this paper to discuss the results of the pilot study.

Once the results of the pilot study are evaluated and the EMASH updated accordingly, the test will be administered to approximately 400 students. The sample will be stratified by age, school type and geographical districts. The parental consent form will be distributed to all the Form 4 students of the selected schools, in order to recruit students of different abilities. This is so since in state schools students are set by ability and in church and independent schools the abilities are mixed. Analysis of Variance (ANOVA) will be used to establish whether mean scores differ significantly between the several independent groups, in this case clustered by geographical districts, school type, gender and writing tasks. Mixed multilevel modelling will be used to estimate the variance component at each level of nesting and determine the within school and between school variance for writing speed scores. The Pearson correlation test will be carried out to assess the relationship between the variables, for instance, learning disability and writing speed, and to determine if learning disability affects writing speed. For predictions, regression analyses will be used, and for the standardization process, reliability statistics will be utilized. Data validity and reliability measures will be carried out by retesting 10% of the participants and comparing performance of participants on the EMASH and the DASH in parallel forms testing.

8 Funding

The main author has been granted paid study leave for one scholastic year.

¹ Students in secondary schools may be following programmes of learning at different levels of difficulty in a number of subjects. These educational programmes may be referred to as Track 3, Track 2 and Track 1, Track 3 being the most demanding.

9 Conflicts of Interest

The author/s report/s no conflicts of interest.

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Appendix A

Text to be copied for the English *Copy from the Board* subtest

“Until very recently, most experts² on climate have said that it is highly unlikely that record temperatures and unusually heavy rains are linked to global warming. However now, it has been discovered, that there is a connection between some weather events and global warming. Several hundred scientists from all over the world contributed to the detailed report. According to the report, climate change makes extreme weather events more probable. The researchers say that a drought may be twenty times more likely because of man-made climate change. However, not all the weather events the scientists studied in their report were linked to climate change.”

(Adapted from the comprehension text of the 2014 English Annual State Past Paper for Form 4 Secondary – Track 3)

Appendix B

Text to be copied for the Maltese *Copy from the Board* subtest

“Sġira indigena Maltija hija s-sġira nazzjonali, is-sġira tal-Għargħar, li thaddar is-sena kollha. Il-weraq tagħha huma rqaq, fuq zkuk kannella fl-aħmar, u huma dawn li jagħmlu s-sġira tiflaħ ħafna għan-nixfa u l-melħ. Il-frotta ta’ din is-sġira tissejjah prinjola. Go fiha issib iż-żerriegħa li tinxtered mar-riħ. Kull żerriegħa ssibilha par ġwienah wesghin, qishom tal-karta, biex ittir, u għalhekk is-sġira l-ġdida ma tikbirx tmiss m’ohra. L-Għargħar hija sġira rari li fl-Ewropa u tinstab biss f’Malta u Spanja. Fil-gżejjer Maltin tikber fis-selvaġġ f’xi ħames postijiet biss, u f’uħud minn dawn l-inħawi tikber ma’ xi blat minkejja li jkun hemm nuqqas ta’ ħamrija.”

(Adapted from the 2013 Maltese Listening Comprehension Teacher’s Paper for Form 4 – Track 3 in turn adapted From an article by Zach Engerer, published in the December issue of 2009, volume 306, of *Sag tar*)

Translation

(A Maltese indigenous tree is the national tree, the Araar tree, which is an evergreen tree. Its leaves are very narrow, on brownish red twigs, and they are these that make this tree resistant to droughts and salinity. This tree’s fruit is called pine cone. Inside there are seeds that disperse with the wind. Every seed has a pair of wide wings, similar to paper, which enables it to glide, and so the new tree does not grow in close proximity to another. The Araar tree is a very rare tree in Europe, and is found only in Malta and Spain. On the Maltese islands this tree grows in the wild, in only five locations, and in some of these places, it grows in rocky areas despite the lack of soil.)

2 Experts not cited.

