

He gave Rose a rose: The Use of Cues to Capitalisation by Children and Adults

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Statement of Sources

I declare that this report is my own original work and that contributions of others have been
duly acknowledged.

Signed:

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Abstract

Capitalisation is an important spelling feature, used for proper nouns and sentence-initial words, that has been neglected in previous research and theories. A new theory, Integration of Multiple Patterns (IMP; Treiman & Kessler, 2014) suggests that people make spelling decisions on the basis of converging linguistic cues. Unlike traditional theories, which focus on letter patterns and relationships, IMP applies to broader spelling functions, but has been tested only retrospectively. The current study represents the first prospective test of IMP: assessing whether capital use increases as capitalisation cues accumulate. A capitalisation fill-in-the-blanks task and a standardised spelling task were completed to dictation by 205 students (65 primary, 60 secondary, and 80 university). The results demonstrated that primary students did benefit from accumulating cues, capitalising two-cue words (sentence-initial proper nouns) significantly more than one-cue words (sentence-medial proper nouns and sentence-initial common nouns) and these more than no-cue words (sentence-medial common nouns). Within the one-cue conditions, they capitalised proper nouns significantly more often than sentence-initial words. Conversely, secondary and university students capitalised one-cue words just as well as two-cue words. These results support IMP as a framework for primary children's spelling acquisition, and suggest that capitalisation should be revised in late primary school.

Capitalisation refers to the use of an uppercase form for a word-initial letter, often to indicate the word's importance (Nowak, 2020). In English, words that require capitalisation include proper nouns and sentence-initial words. Capitalisation is yet to receive much empirical attention, so we know very little about the acquisition and accuracy of children's capital letter use. As a silent element of spelling, capitalisation is not well accounted for by traditional spelling theories, which often focus on the relationships between sounds and letters (Treiman, 2017). In 2014, Treiman and Kessler proposed a new spelling theory, known as the *Integration of Multiple Patterns* (IMP), that addresses this shortcoming. IMP suggests that spellers are influenced by various language patterns when they decide how to spell a word. Some patterns are *phonological* (sound-based, e.g., “dog” starts with the sound /d/), others are *graphotactic* (conventions about sequencing, e.g., English words cannot end with “v”, sentences start with a capital letter) and still others *morphological* (word structure conventions, e.g., plurals end in “s”, whether pronounced as in “cups”, /s/, or “mugs”, /z/).

According to IMP, the likelihood of selecting a given spelling increases with the number of patterns cueing it. A cue is a probabilistic or *deterministic* (all-or-none) pattern that motivates the choice of a particular spelling (Treiman & Kessler, 2014). Conceptually simple, IMP is applicable to both phonological and nonphonological spelling patterns. IMP has been devised from previous research findings, but to our knowledge, no studies to date have been designed to directly investigate the theory's claims. The aim of the current study was to assess whether the claims of IMP hold for the case of a graphotactic spelling feature: capitalisation. Specifically, it assessed whether spellers are more likely to capitalise as the number of capitalisation cues increase. Spelling ability generally increases with age and grade (Ehri, 2020). Thus, the current study also aimed to investigate how capitalisation use changes with education level, and to examine the relationship between spelling and capitalisation abilities.

Spelling and Capitalisation

When learning to spell, children first learn the characters that comprise their language. In English, these are the letters of the Latin alphabet. Children must learn how written letter patterns (*graphemes*) correspond to sounds (*phonemes*), as well as the graphemes that can and cannot appear together in a written language. These are known as *graphotactic* patterns (Treiman, 2017). For example, in English, “ck” can occur in word-final, but never word-initial position. Graphotactics also include broader patterns, such as where capitals can be used in a word (e.g., capitals cannot appear in the middle of a word, as in “bAll” or “frieND”). With experience, children learn to integrate these graphotactic skills with broader grammatical information, both contextual (sentence position of a word) and morphological (word type) to solidify their spelling (Treiman, 2017).

Many languages that use the Latin alphabet distinguish between uppercase and lowercase letters. Uppercase forms are overused in children’s early spelling because they are often learned first: this may be due to their distinctive shapes and higher rates of symmetry than in lowercase letters (Treiman & Kessler, 2014). As children learn to integrate lower- and uppercase letters, they learn to reserve capital letters for special cases (Treiman & Kessler, 2014). In the English writing system, these are sentence-initial words, proper nouns (e.g., “Australia”) and their derivations (e.g., “Australians”; Edwards, 2010). As early as six years of age, children appear to be developing their graphotactic understanding of capitalisation: even before any formal teaching, they are more likely to capitalise a word-initial letter than any other letter position (Treiman & Kessler, 2004). At this young age, a child is most likely to incorrectly use a capital where it does not belong when it is the initial letter of their own name. For example, Alice may write “cAt” for “cat”. This may be because young children are disproportionately familiar with their name-initial letter in its uppercase form (Treiman & Kessler, 2004).

To have a functional understanding of capitalisation, however, a child also needs to understand the contextual and morphological purposes of capitalisation (Treiman, 2017). This is more integral to some languages than others. For example, German capitalises all nouns, as well as some adjectives and verbs, and so German speakers require a thorough understanding of word type and context to write conventionally (Bilici et al., 2020). German schools teach capitalisation through approaches based on word class (involving the semantic categorisation of words) or syntax (understanding a word's function in a sentence; Bilici et al., 2020). The former is limiting for students of poorer spelling ability, but the latter may be more sustainable and accessible to all learners of German (Bilici et al., 2020; Wahl et al., 2017). Literature regarding pedagogical capitalisation practices is sparse in English, however. Indeed, the little research that does exist is particularly descriptive, and in some cases, rather outdated. While some of these studies are no longer representative of how capitalisation is taught today, they still provide insight into how children use capital letters (Evans, 2015), as described below.

Proper Noun Capitals

In English, proper nouns are capitalised as words of importance because they refer to the identity of a singular person, object or place, rather than that of a collective (Cambridge University Press, 2008). In Australia, children are taught in the first (preparatory) year of school (Prep in Tasmania) that capitals initialise names, and this rule is extended to all proper nouns by the end of Grade 2 (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2015). We found only three studies published over the last century that addressed children's adherence to this rule. In one early study, the omission of capitals from proper nouns accounted for 2.9% of spelling errors in (epistolic) letters written by children in Grade 5 (10–11 years old, $n = 748$, Geoghegan & Fitzgerald, 1935). Odom (1962) assessed this issue experimentally with children in Grades 4 to 6 (ages not specified, $n = 1818$) by

comparing individual capitalisation skills. We reanalysed these data, combining the scores relevant to our study, and found that Odom's (1962) participants improved in their capitalisation of proper nouns between Grades 4 (M correct = 56.2%, SD = 14.2%) and 6 (M = 70.1%, SD = 11.0%), $t(11) = -9.01$, $p < .001$, but still made many errors.

To our knowledge, only one recent study has addressed the capitalisation of proper nouns in English: an Honours study with Tasmanian children. In this dictation study, children in Grades 3 and 4 (aged 8–10 years, $n = 55$) correctly capitalised proper nouns 70% of the time, and correctly omitted capitals from 80% of common nouns, with no improvement following an intervention on capitalisation (Evans, 2015). In a smaller pilot study, Evans (2015) found that the scores of older children in Grades 5 and 6 (aged 10–12 years, $n = 19$) did not significantly differ from the younger children's scores. Clearly, children in late primary school know enough to correctly apply capitalisation most of the time, but may not have grasped the more complicated factors by this age. Indeed, they may understand the visual aspects of capitalisation (e.g., "Australia" is always written with a capital "A"), but may lack linguistic awareness of the underlying rules of function (e.g., "Turkey" is capitalised for the country but not for the bird; Evans, 2015).

Sentence-Initial Capitals

In many alphabetic languages, sentence-initial words start with a capital letter to optimise reading fluency (Treiman & Kessler, 2014). Australian children are taught this rule in their preparatory year (ACARA, 2015). Geoghegan and Fitzgerald (1935) found that the omission of a sentence-initial capital accounted for 5% of the errors made by fifth-grade (10- to 11-year-old) children when writing epistolic letters. According to our reanalysis of Odom's (1962) data, combining the scores that involved capitalising sentence-initial words, the children improved significantly in this ability between Grades 4 (M correct = 51.7%, SD =

19.2%) and 6 ($M = 61.9\%$, $SD = 16.1\%$), $t(3) = -5.26$, $p = .013$, but still made many mistakes.

These previous studies are by now very old indeed, and are limited in their generalisability to modern education systems (Evans, 2015). A more recent intervention study (Vernon et al., 2004) taught punctuation skills to 7- and 8-year-old children ($n = 21$). By their second drafts of a written piece, 86% of the children capitalised the start of a body of text, but only 57% separated their clauses with a full stop and a following (i.e., sentence-initial) capital letter. In their third drafts, however, all children correctly demonstrated both abilities (Vernon et al., 2004). These findings suggest that primary-aged children may be aware of, but have not yet internalised, the rule to capitalise sentence-initial words. Hence, more research is required before we can form conclusions about children's ability to capitalise sentence-initial words.

Age-Based Patterns in Capitalisation

The Australian Curriculum provides no mention of capitalisation skills from Grade 3 onwards (ACARA, 2015), implying that by Grade 3, children have been taught all relevant knowledge about capitalisation. The sparse previous research suggests that children improve in their capitalisation abilities over time, but still make mistakes until at least Grade 6 (Evans, 2015; Odom, 1962). Therefore, children in Grades 3 to 6 are pivotal participants to test in capitalisation research: they are expected to know how to use capitals, but are still developing in their spelling skill. If so, a meaningful comparison can be made by testing older children and adults, to understand when, and to what extent, capitalisation abilities may develop. Spelling ability varies considerably within any age group (Ehri, 2020), and so recording participants' standardised spelling scores can confirm that grade-based groupings are representative of their real spelling skill (Kemp & Bryant, 2003).

There is very little research directly addressing adults' and adolescents' capitalisation abilities. As with general spelling skill, it is likely that capitalisation skills improve with age. The aforementioned Honours study (Evans, 2015) included a small adult sample ($n = 26$), and found that adults correctly capitalised proper nouns at ceiling ($M = .99$, $SD = .05$), which they did significantly more often than correctly omitting capitals from common nouns ($M = .89$, $SD = .20$). These adults were correct in their overall use of capitalisation a significantly higher proportion of the time ($M = .95$, $SD = .10$) than were children in Grades 3 to 6 ($M = .75$, $SD = .18$), $F(1, 79) = 25.15$, $p < .001$, $\eta_p^2 = .241$. This finding supports the current study's testing of an adult sample, for it implies that children will improve in their capitalisation abilities. Two descriptive studies suggest that capitalisation errors are some of the most frequent in adolescent and early adult writing (accounting for 8% and 5.2% of errors, respectively), but these studies did not undertake experimental analyses (Lunsford & Lunsford, 2008; Wilcox et al., 2014). Comparing adults and adolescents to primary students can both fill this gap in the literature and identify what level of accuracy we might expect children to attain (Evans, 2015). With the ever-changing nature of writing, however, cross-sectional spelling studies must consider the effect of writing *modality*. Much of today's communication is digital (Australian Bureau of Statistics, 2018), but children more commonly handwrite when learning and when completing assessments (ACARA, 2015). Digital devices often automatically capitalise for the writer, and so people may become accustomed to this device-corrected action. If we had asked participants to type their answers into a word-processing program with autocorrect disabled, we would not know whether any omitted capitals represented a lack of knowledge, or the (incorrect) expectation that the device would automatically capitalise the word. For these reasons, we tested all participants in a handwritten format.

Traditional Theoretical Approaches to Spelling

Most traditional spelling theories emphasise the role of phonology when children are learning to spell, but have limited ability to explain nonphonological contributions to spelling (Treiman & Kessler, 2014). For example, phase theories (e.g., Ehri, 2020; Gentry, 1982) assert that spellers are able to deal with increasingly complex correspondences between phonemes and graphemes over time, and will apply a rule consistently once it is learned, but not before (i.e., *all-or-none*). In the early stages of phase theories, children are seen to focus on matching sounds with letters; it is not until the most advanced stage that children apply graphotactic and other contextual knowledge to spelling. However, other research has shown that nonphonological factors (including graphotactics) are present in spelling from a very early age. For example, even beginning spellers reproduce letter patterns according to the frequency with which they appear in children's literature (Kessler et al., 2013). Phase theories do not adequately explain how children learn to use capitals, because they underrepresent the role of such nonphonological elements of spelling (Treiman, 2017). They also fail to account for the interactions between different types of patterns that underlie the whole spelling process, a shortcoming that is addressed by IMP (Treiman & Kessler, 2014).

Integration of Multiple Patterns

Not all incorrect spellings are equal: neither “kt” and “vvv” are accurate spellings of *cut*, but the first demonstrates more spelling knowledge than the second (Treiman, 2017). Treiman and Kessler's (2014) IMP theory claims that children spell new words by combining linguistic patterns they have previously learned. Consequently, selecting a given spelling increases in likelihood with the number of patterns supporting its use. Spelling patterns can be learned *implicitly* through exposure to the frequency and conditions in which they occur (Treiman & Kessler, 2014). This is known as *statistical learning*. For example, a child may spell “head” correctly from the first time, because they have frequently seen the phoneme /ɛ/

spelled as “ea” when it precedes a “d”, although not when it precedes other consonants (e.g., “heat”, “heal”; Treiman & Kessler, 2014). According to IMP (Treiman & Kessler, 2014), patterns become spelling cues when they are observed at a sufficiently high frequency, because the pattern has demonstrated success on many occasions. Reliance on observational frequencies is not always practical, as with unconventional spellings such as “yacht” (Kemp, 2016), and thus statistical learning can be aided by explicit teaching. IMP asserts that children’s learning is accelerated when they both receive instruction about a spelling rule, and observe the rule in practice. Treiman and Kessler (2014) used previous findings to develop and refine IMP.

One set of studies that Treiman and Kessler (2014) focused on when developing IMP relates to the spelling of “flaps”. For speakers of American English, a /t/ can sound like a /d/ when presented in a word-medial position, due to the brief flap of the tongue to the back of the teeth (Herd et al., 2010). Therefore, words that differ only by this word-medial letter (e.g., “ladder” and “latter”) are pronounced identically. Treiman et al. (1994) tested children’s spelling of one- and two-morpheme words that include a word-medial /d/ or /t/. Knowledge of morphological rules would allow spellers to apply their familiarity with a stem word (e.g., “cute” or “read”) to inform their spelling of the “t”/“d” of related two-morpheme words (e.g., “cuter” or “reader”). Here, therefore, two types of patterns are at play: phonology and morphology. Two-morpheme words with a word-medial “d” (e.g., “reader”) were most frequently spelled correctly, because both phonology (the flap makes a /d/ sound) and morphology (“reader” is derived from “read”) supported the choice to use “d”. IMP would suggest that two cues converged on the “d” spelling (Treiman, 2017). Words where the two patterns were in conflict, such as “cuter” (phonology suggests “d”, morphology suggests “t”) were less often correctly spelled. For one-morpheme words, there was no stem word on which to base a spelling, leaving phonology as the only cue. Here, words with a word-medial

“d” (e.g., “ladder”) were spelled better than those with a word-medial “t” (e.g., “latter”), because the flap produced a phonological cue for only the former, leaving the latter with no cues (Treiman et al., 1994).

The current study was intended as the first prospective test of IMP, and was designed to determine whether similar principles apply to capitalisation. According to IMP, when there is spelling ambiguity, a young writer is more likely to choose the spelling on which the most patterns converge. Consequently, the choice to capitalise a word is more likely when multiple patterns cue capitalisation than when there is only a single cue, and refraining from capitalisation is likely when no cues are present. In English, positioning a word at the start of a sentence *cues* the writer to use a capital letter, because sentence-initial words are always capitalised, regardless of their word type. Similarly, proper nouns can cue capitalisation. Proper nouns are the only type of word that is routinely capitalised in English, and therefore, usually have only one orthographic representation in memory for English spellers (i.e., only exist in memory in capitalised form; Treiman & Kessler, 2014). Homographs (spellings that have multiple meanings, e.g., “Rose”, the personal name, vs. “rose”, the flower) are exceptions to this rule, because a proper noun and common noun share the same spelling (Preiss & Stevenson, 2013). Common nouns also have two orthographic representations because they are typically uncapitalised, unless appearing at the start of a sentence or standing in place of a proper noun (e.g., “[I’m telling] **Mother**”; Odom, 1962). Hence, common nouns should not cue capitalisation.

Only two studies have compared children’s adherence to proper noun and sentence-initial capitalisation rules. These studies suggest that 9- to 12-year-old English speakers may make fewer capitalisation errors for proper nouns than for sentence-initial words, but that any such effect is small (Geoghegan & Fitzgerald, 1935; Odom, 1962). While Geoghegan and Fitzgerald’s (1935) descriptive study can make no experimental claims, our reanalysis of

Odom's (1962) results found that proper nouns were capitalised numerically ($M = 63.4$, $SD = 13.3$), but not significantly, more often than were sentence-initial words ($M = 56.8$, $SD = 16.6$), $t(11) = 0.09$, $p = .929$. To our knowledge, no experimental studies have considered how combining these cues may influence capitalisation. The current study provides a new way to test this question.

IMP would predict that capitalisation is best supported for a proper noun at the start of a sentence, because both cues support the choice to capitalise (Treiman & Kessler, 2014). When a different word type (e.g., common noun, adjective) appears at the start of a sentence, however, the cues stand in conflict: sentence position encourages capitalisation, whilst word type discourages it. A similar conflict occurs when a proper noun appears partway through a sentence (i.e., not at the start). In these cases, IMP suggests that the speller is less compelled to capitalise than when both cues converge on capitalisation as the correct decision. However, the model makes no clear prediction about the comparative strength of these two cases, wherein both provide one cue to capitalisation. When there are no cues pointing to capitalisation, the speller is discouraged from using a capital. Therefore, a better speller should capitalise more often when cues are present, and less often in the presence of no cues, than should a poorer speller. Indeed, as broader spelling conventions are still a part of spelling, it is logical to expect that that spelling ability is related to capitalisation ability, but this has not been addressed in previous research or theory.

The Current Study

The primary aim of the current study was to test IMP's claims that participants' decisions to capitalise would increase in proportion with the number of cues signalling capitalisation. Therefore, it was hypothesised that the proportion of words capitalised in two-cue conditions (sentence-initial proper nouns) would be significantly higher than the proportion of words capitalised in one-cue conditions (sentence-medial proper nouns, or

sentence-initial common nouns), and these significantly higher than the proportion of words capitalised in uncued conditions (sentence-medial common nouns). For the two one-cue conditions, we tentatively hypothesised (based on findings by Geoghegan & Fitzgerald, 1935, and Odom, 1962) that the proportion of words capitalised would be significantly higher for proper nouns than for sentence-initial words.

The current study also aimed to investigate the effects of education level on capitalisation decisions. On the basis that spelling improves with age and grade (Ehri, 2020), we predicted that the proportion of words capitalised overall would increase significantly with education level. However, we note that it is correct to capitalise two-cue and one-cue conditions, but not uncued conditions. Therefore, we hypothesised that all education levels would capitalise a significantly higher proportion of words in one- and two-cue conditions than in no-cue conditions, but that education level would interact with cued word type conditions. Specifically, we hypothesised that the proportion of words capitalised by primary and secondary students would be significantly higher for two-cue than for one-cue conditions. However, we assumed that university students would perform so close to ceiling that we would see no significant differences in the proportion of words capitalised between one- and two-cue conditions.

The final aim was to examine whether spelling ability is associated with the ability to correctly use and avoid capitals. We hypothesised that absolute and standardised scores on the spelling subtest of the Wide Range Achievement Test would be positively correlated with the proportion of words capitalised in one- and two-cue conditions, and would be negatively correlated with the proportion of words capitalised in the no-cue condition. Given the more exploratory nature of this prediction, we made no hypothesis about correlation strength.

Method

Participants

For the primary school sample, 66 children in Grades 3 to 6 were recruited from one government school and one community group in southern Tasmania. One participant was removed for missing excessive words in the cloze task. Thus, 65 participants remained, ranging in age from 8.8 to 12.8 years ($M = 10.6$, $SD = 0.9$). The sample was 44% female (38% male, 18% no answer). Mean spelling ability was tested by the spelling subtest of the *Wide Range Achievement Test* (WRAT-4; Wilkinson & Robertson, 2006). The mean WRAT-4 score of 106.2 ($SD = 15.9$) suggested that the sample was within the normal range, based on a standard score of 100 ($SD = 15$).

The secondary school group comprised 60 students in Grades 7 to 12 from two southern Tasmanian government schools and one community group. The participants ranged from 12.8 to 18.0 years of age ($M = 15.1$, $SD = 1.7$) and were predominantly female (63%; 32% male, 3% other, 2% provided no answer). The sample's mean WRAT-4 score of 112.6 ($SD = 15.4$) was within the normal range.

The university sample comprised 82 third-year psychology students. Two participants were removed from the analysis, as they wrote completely in capitals. In total, 80 participants completed this condition, with a mean age of 26.0 years ($SD = 8.7$, range = 20–63). The sample was mostly female (76%; 24% male), and their mean spelling ability was within the normal range ($M = 111.0$, $SD = 11.1$).

Four participants (one primary, one secondary, two university) read and wrote in a first language whose capitalisation rules differed from English rules. Visual inspection of capitalisation and WRAT-4 scores suggested that these participants did not differ substantially from their peers, and so their scores were retained in the analyses.

Materials

Researcher-devised cloze task

The researchers devised 20 pairs of matched sentences to test the effect of the two linguistic cues (noun status and sentence position) on capitalisation choice. Each sentence contained two target words, both nouns, varying in noun status (proper or common) and in sentence position (initial or medial), as shown in Table 1. “Sentence-medial” refers to any non-initial position within the sentence, not necessarily in the middle. In any such position, capitalisation is not the default, as it is in sentence-initial position. The range of proper noun categories included personal names, the pronoun “I”, time words, place names and their derivations, brand names, and religious holidays. There were thus four word type conditions: sentence-initial proper nouns (two cues to capitalisation), sentence-medial proper nouns (one cue), sentence-initial common nouns (one cue) and sentence-medial common nouns (no cues). There were 40 target words (10 per condition), to allow enough scope for variation within individuals’ scores without overburdening our youngest participants.

Sentences were created in pairs matched in structure, so that one version of a particular structure was allocated to Set A and the other to Set B (between-sets pairing), as shown in Table 1. All sentences with Structure 1 contained a sentence-medial proper noun (one cue to capitalisation) and a sentence-initial common noun (one cue). Conversely, sentences with Structure 2 contained a sentence-initial proper noun (two cues) and a sentence-medial common noun (no cues). Between-set pairs were also matched in their proper and common noun categories (e.g., weekdays, foods). The Structure 2 sentence of each between-sets pair was created by rephrasing the pair with Structure 1 to reverse the positioning of the target words. Sentences with the second structure were allocated to the opposite set from their Structure 1 pair, so that each target word appeared once in each set

and once in each sentence position (see Table 1). Thus, within-sets pairs were matched for proper and common noun categories, whilst presenting each cue combination of noun status and sentence position. These between- and within-set pairings produced four sentences with a common overall theme, such as those shown in Table 1.

Table 1

Example Sentences Illustrating Cue Conditions, Set and Structure Distributions

Noun status	Sentence position	Example sentence	Set	Structure
Proper	Initial	<u>Friday</u> is music day at school.	B	2
	Medial	Baking day at home is <u>Monday.</u>	B	1
Common	Initial	<u>Music</u> day at school is Friday.	A	1
	Medial	Monday is <u>baking</u> day at home.	A	2

Note. All target words are bolded, but those illustrating the cue combination (noun status and sentence position) are underlined. The underlining and bolding were not presented in the stimuli, as participants were always presented with underscores in place of target words.

Four filler sentences were also created to discourage participants from noticing that the target words assessed the use of capitalisation. These sentences illustrated other spelling patterns (homophones, e.g., “flour”/“flower”, and apostrophes, e.g., “cat’s”/“cats”) and exclusively used sentence-medial common nouns as filler words. The same four filler sentences were included in both sets of sentences (A and B), because they were not being analysed, and therefore did not require matched pairs.

In creating the sentences, we carefully chose target words whose initial letter’s upper- and lowercase forms differed in shape as well as size (e.g., “E”/“e” or “N”/“n”) rather than only in size (e.g., “V”/“v”). This was to reduce the ambiguity of coding where a participant’s capital letters were not clearly larger in size than their lowercase letters. This might be especially common in younger children whose graphomotor skills are still developing (Seyll

& Content, 2020). Only two target words (“Christmas”, “Sam”) failed to satisfy this criterion. These words were retained due to the limited number of words in these proper noun categories that were simple to spell, matched in word frequency with their paired word and were of appropriate familiarity to the tested populations. When selecting brand names, we chose brands who present their logo in title case (e.g., “Banjo’s”, as compared to “coles”).

We also carefully matched the word frequency of the target words between sets to ensure that the words were of sufficiently high frequency to be familiar to even our youngest participants. This meant that the words were relatively easy to spell, and should have reserved cognitive resources for considering the need for capitalisation (Treiman & Kessler, 2014). Target words were analysed for frequency according to the set in which they appeared as the sentence-initial word (e.g., “Monday” in Set A, and “Friday” in Set B; see Table 1). This enabled us to confirm that the between-set pairs did not significantly differ in terms of word frequency. The pronoun “I” appeared in both sentence positions in both sets, having no one-letter pronoun equivalent, and was therefore not included in the word frequency comparisons.

As there exists no Australian-English-specific word frequency measure, we instead calculated both SUBTLEX_{US} (American English, *frequency per million words*; Brysbaert & New, 2009) and SUBTLEX-UK measures (British English, *Zipf scale*; van Heuven et al., 2014). SUBTLEX word frequency measures are derived from subtitles from media programs in their respective countries. We chose target and filler words whose frequencies fell above one word per million in the SUBTLEX_{US} measure (which applies to both children and adults), or above 3.5 on the logarithmic Zipf scale devised for SUBTLEX-UK measures (for children (*CBBC*) and adults (*standard*), van Heuven et al., 2014). This was because the UK measures deemed the low/high-frequency threshold to fall between 3 (one per million words) and 4 (one per 100 thousand words; van Heuven et al., 2014). We made five exceptions to this criterion, where we judged that the words were likely to be more familiar to Tasmanian

than UK/US populations: namely, “Tasmania”, “Queensland”, “Australians”, “Banjo’s” and “Nando’s”. These words were included in the word frequency analyses, and did not affect the between-set comparisons shown in Table 2.

Table 2

Sentence Set Comparisons of Word Frequency and Sentence Length Measures

Measure	Set A		Set B		t (df)	p	Cohen’s d
	M	SD	M	SD			
SUBTLEX-UK CBBC	4.51	1.00	4.49	1.00	0.01 (27)	.922	-0.02
SUBTLEX-UK (standard)	4.54	0.90	4.44	0.93	1.12 (27)	.273	-0.11
SUBTLEX-US	1601	7827	1545	7681	-0.30 (25)	.766	-0.01
Words per sentence	6.17	1.13	6.21	1.14	-0.37 (23)	.714	0.04
Syllables per sentence	8.50	1.64	8.54	1.84	-0.18 (23)	.857	0.02

The degrees of freedom differed between SUBTLEX_{US} ($df = 25$) and SUBTLEX-UK ($df = 27$) because “Nando’s” (included for Set A in word frequency analyses), “Queensland” (Set A) and “Tasmania” (Set B) did not appear in the SUBTLEX_{US} corpus. The degrees of freedom for the words per sentence and syllables per sentence were different again ($df = 23$) because these measures only counted each sentence once, whereas the word frequency analyses included both filler words from each sentence in each set. This was the case because the filler sentences were the same (rather than reversing the positions of the target words) in Set A as in Set B, and did not have matched pairs.

Thus, two sets of 24 sentences were formulated, and two randomised orders were generated per set to diminish any possible order effects. The final sentence sets are shown in

Appendix A. The sentences were presented as a cloze task: in the written stimuli, the target words were replaced with blanks (e.g., “_____ enjoys playing _____.”), where participants were required to spell the missing words they heard dictated within the sentence.

WRAT-4

All participants completed the WRAT-4 spelling subtest (a series of 42 progressively difficult words; Wilkinson & Robertson, 2006) as a measure of overall spelling ability. The words were dictated in the context of a sentence. Children in Grades 3 to 10 began with the first word (“go”) and progressed until the experimenter, observing the group’s responses, judged that all children had reached the “stop” point of ten incorrectly spelled words in sequence. Adults and college students were tested from the tenth word (“train”) onwards to minimise time requirements, in line with the manual’s recommendations for older spellers.

Design and Analysis

The data were analysed with a mixed analysis of variance (ANOVA), with one repeated measure (word type: proper initial, proper medial, common initial, common medial) and one between-subjects factor [education level]. This analysis was chosen over a two-way ANOVA with two repeated measures: noun status (proper, common) and sentence position (initial, medial). In a two-way ANOVA, a significant main effect of either noun status or sentence position would combine one- and two-cue conditions in the one level, and one- and no-cue conditions in the other, and would thus complicate the interpretation of any main effects. For example, a main effect of noun status would combine words with one cue (sentence-medial proper nouns) and two cues to capitalisation (sentence-initial proper nouns) in one level of the variable, and words with one cue (sentence-initial common nouns) and no cues (sentence-medial common nouns) in the second level.

Our main interest was in examining the effect on capitalisation use of the *number* of cues (determined by the combination of noun-status and sentence-position levels) rather than

comparing the overall *types* of cues. Therefore, if we conducted the two-way ANOVA described above, the only way to evaluate IMP's claims would be in interpreting the interaction between noun status and sentence position (specifically, testing whether the capitalisation rate would increase with the number of cues presented). For this reason, we chose to use a mixed ANOVA with four levels (as described above), which itself provides only the interaction. In accordance with our aim to test IMP's claims that people's use of a spelling pattern should increase in line with the number of cues to that pattern, our dependent variable was the *use* of capitals, rather than *correctness*.

Procedure

Ethics approval was obtained from the Social Sciences Human Research Ethics Committee (Appendix B) and from the Department of Education (Appendix C). Demographic information was collected regarding age, grade, gender and first language. Participants whose first language was not English were asked to record whether they spoke in these, and how well they could read and write in these first languages. This was because capitalisation is purely a function of written language, and thus should not be affected if a participant speaks, but does not write, in another first language.

Once school principals agreed to participate, the parents or caregivers of children in relevant grades were sent an information sheet and consent form (Appendix D). Children whose caregiver had signed the consent form were given their own explanation in age-relevant language on the day of testing (Appendix E). Grade 11 and 12 students provided their signature to confirm their consent. Third-year psychology students completed the study as a practical exercise for their Psychology of Language undergraduate unit. The participants were provided with information sheets prior to testing and returned signed consent forms in their practical class (Appendix F).

Participants were tested in groups of 4 to 39 in a quiet room. Answer sheets were provided in 14-point Calibri font (Appendix G). These included the numbered cloze sentences (with underscored ‘blanks’ in place of the target words) and a numbered table for the WRAT-4. The researcher provided verbal instructions before the cloze task, and again before the WRAT-4. Each cloze sentence was read twice, emphasising the two target words. The WRAT-4 was delivered following the standard procedure: the researcher announced the sentence number and the target word before reading the full sentence (emphasising the target word), and then repeated the target word. This WRAT-4 procedure was delivered twice for each word before progressing to the next one. The handwritten conditions took approximately 35 minutes to complete.

Coding

Target words were coded for case, scoring 1 if the word-initial letter was spelled with a capital, or 0 if spelled with a lowercase. Thus, coding was based upon the first letter only: for example, “Novels” or “Novles” scored 1, but “novels” scored 0. While the initial letter of most target words was coded by shape, initial letters that were shaped the same in upper- and lowercase (e.g., “S”/“s”) were coded according to their size relative to other letters in the word. In the few instances where letter case was ambiguous, we followed Treiman and Kessler’s (2004) procedure: ambiguous letters were identified by the student researcher, and then coded separately by the chief researcher, and any differences in opinion were reconciled through discussion. The few missing words were dealt with by calculating each participant’s mean proportional capital use based on the number of words they had written in a given condition.

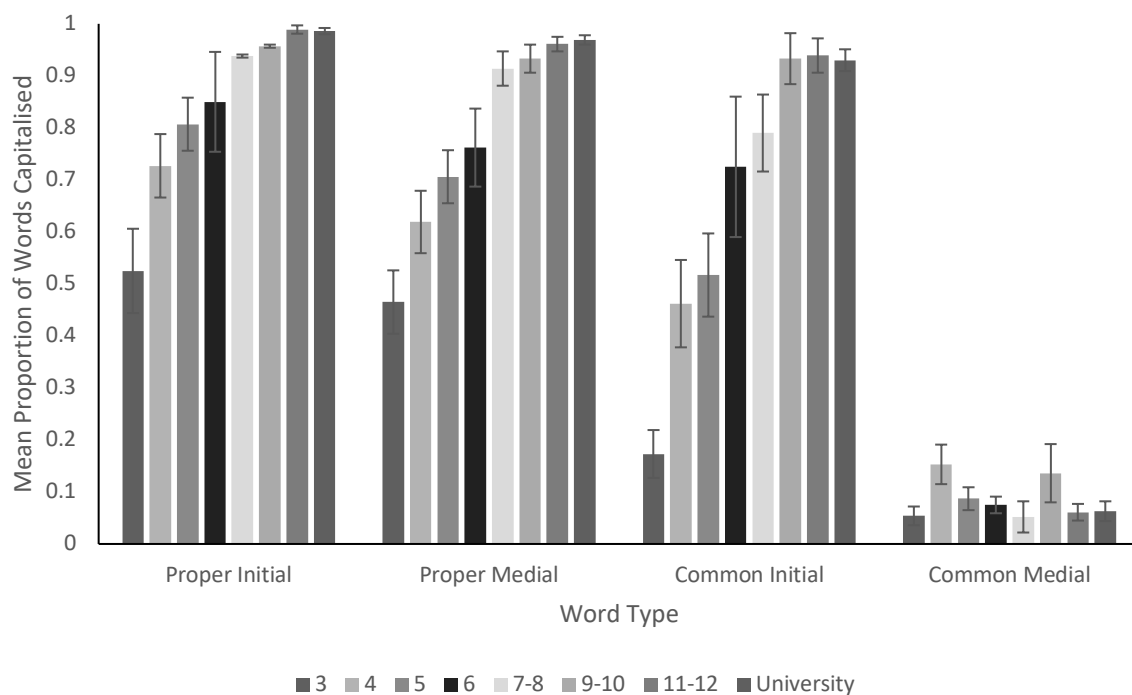
Results

The mean proportion of capitals used across the four cueing conditions by individual grades are presented in Figure 1. We did not conduct analyses at this fine-grained level of

school grade. However, before conducting group-level analyses to test our hypotheses, we wished to observe the trends across school grades to ensure that no substantial effects would be obscured when combining the grades into the broader independent variable of education level.

Figure 1

Mean Proportion (with SEMs) of Word Types Capitalised by Grade



As can be seen in Figure 1, participants across grades used capitals where they were required (*cued* conditions: proper nouns in sentence-initial and sentence-medial positions, and sentence-initial common nouns) more often than where they were not required (*uncued* condition: sentence-medial common nouns). Overall, capitals were used at a similar rate across the three cued conditions. However, this clearly differed with grade. The correct use of capitals (in cued conditions) increased in a stepwise fashion from Grade 3 onwards; rapidly throughout primary school, but with a more gradual increase from high school grades until

university. By university, the correct use of capitals was nearly at ceiling. However, the primary and early high school grades appear to have used capitals less often when there was one sentence-level cue (sentence-initial common nouns) than when there was one word-level cue (sentence-medial proper nouns) or two cues present (sentence-initial proper nouns). However, there were no clear grade-based patterns to the (low) rates of capitalisation within the uncued condition.

For the analysis, we grouped participants according to education level: primary (Grades 3–6; $n = 65$), secondary (Grades 7–12; $n = 60$) and university ($n = 80$). Table 3 displays the mean proportion of capital use for each cueing condition by education level.

Table 3

Mean Proportion (and SDs) of Words Capitalised per Word Type by Education Level

Education level	Proper initial	Proper medial	Common initial	Common medial
Primary	.73 (.29)	.64 (.26)	.46 (.38)	.10 (.13)
Secondary	.96 (.13)	.94 (.12)	.89 (.26)	.08 (.18)
University	.99 (.05)	.97 (.08)	.93 (.19)	.06 (.17)

Table 3 shows that, across education levels, capitals were used more frequently for cued conditions (proper nouns in sentence-initial and sentence-medial positions, and sentence-initial common nouns) than for the uncued condition (sentence-medial common nouns). Secondary and university students capitalised the three cued conditions at a similar rate, capitalising the two-cue condition only slightly more often than the one-cue conditions. However, students in primary school used capitals less often when there was one sentence-

level cue than when there was one word-level cue, and the latter less often than when a word used both cues.

Mauchly's test of sphericity was violated, $W = 0.30$, $p < .001$, $\varepsilon = .64$, and a Greenhouse-Geisser factor was thus applied to the analysis (Hazra & Gogtay, 2016). Specifically, the assumption of variance homogeneity was violated for sentence-initial proper nouns ($p < .001$), sentence-medial proper nouns ($p < .001$) and sentence-initial common ($p < .001$), but not for sentence-medial common nouns ($p = .671$). This was expected because, in theory, participants should capitalise all words in these three cued conditions, which would produce a highly negative skew. There was far less variation in scores for sentence-medial common nouns, which may have reduced the skew for these. The non-parametric Friedman ANOVA would compensate for this skew, but could not be used for this analysis, as it is unable to compare groups (Turner, 2014). Therefore, Friedman's analysis cannot address one of the key research aims: the influence of education level on capitalisation use. However, since the skew was similar between education levels and between cued word types, and the largest variance ($s^2 = .12$) was no more than four times the size of the smallest variance ($s^2 = .03$), the validity of a parametric ANOVA should have remained intact, especially since the sample sizes were relatively similar across education levels (Howell, 2013). Therefore, a parametric repeated-measures ANOVA was deemed appropriate for this analysis.

The repeated measures ANOVA showed a main effect of word type, $F(1.89, 382.27) = 1087.47$, $p < .001$, $\eta_p^2 = .84$, of large effect size. According to a series of Tukey's Honest Significant Difference post hoc tests (see Appendix H for the full output), all cued conditions (two- and one-cue) were capitalised significantly more often than were sentence-medial common nouns (no cues, all $ps < .001$). The two-cue condition (sentence-initial proper nouns) was capitalised significantly more often than were the one-cue conditions (sentence-medial proper nouns, $p < .001$, and sentence-initial common nouns, $p < .001$). When

comparing the one-cue conditions, capitals were used significantly more often for the word-level cue (sentence-medial proper nouns) than for the sentence-level cue (sentence-initial common nouns; $p < .001$). Therefore, it appears that capitalisation significantly increased with the number of cues presented, and that the word-level cue was stronger than the sentence-level cue.

A main effect of education level, $F(2, 202) = 65.11, p < .001, \eta_p^2 = .39$, was also of large effect size. Tukey post hoc tests demonstrated that university and secondary students used capitals significantly more often than did primary students ($ps < .001$), but there was no significant difference between university and secondary ($p = .968$). This suggests that the use of capitals does not continue to increase after high school.

These significant main effects were subsumed by a significant interaction between word type and education level, $F(3.79, 382.27) = 34.94, p < .001, \eta_p^2 = 0.26$, of large effect size. Tukey post hoc tests also identified significant differences within the interaction (see Appendix I for the full output). Within all education levels, sentence-medial common nouns (no cues to capitalisation) were capitalised significantly less often than all other word types (all $ps < .001$), and the limited, incorrect use of capitalisation for these sentence-medial common nouns did not significantly differ between the three education levels (all $ps > .96$). Primary students capitalised proper nouns significantly more often in sentence-initial than in sentence-medial position, and capitalised both proper noun conditions (sentence-initial and sentence-medial) significantly more often than they capitalised common nouns in sentence-initial position (all $ps < .001$). Hence, primary students capitalised words with two cues more frequently than words with one cue, although single cues were more effective at the word level than at the sentence level.

Secondary and university groups both capitalised sentence-initial proper nouns, sentence-medial proper nouns and sentence-initial common nouns significantly more often

than the primary group (all $ps < .001$). However, secondary students did not significantly differ in their capitalisation rate of proper nouns in sentence-initial and sentence-medial positions ($p = .752$), sentence-initial proper and common nouns ($p = .180$), nor between sentence-medial proper and sentence-initial common nouns ($p = .789$). The same was true of university students ($p = .926$, $p = .383$, and $p = .887$, respectively). Furthermore, secondary and university students did not significantly differ from one another in their capitalisation of sentence-initial proper nouns, sentence-medial proper nouns, nor in sentence-initial common nouns (all $ps > .990$). This suggests that, for secondary and university students, having two cues to capitalisation provided no benefit beyond that of one cue.

Finally, as shown in Table 4, a set of Pearson's correlations was run to analyse whether spelling proficiency was related to the participants' correct use and avoidance of capitals. Standardised WRAT-4 scores were positively and moderately correlated with the correct use of capitals for sentence-initial proper nouns, sentence-medial proper nouns, and sentence-initial common nouns, but were negatively and weakly correlated with the incorrect use of capitals for sentence-medial common nouns. Therefore, this suggests that those who were better spellers *for their age* were also better at correctly using and avoiding capitals. The same pattern emerged between word type and raw WRAT-4 spelling scores (as a measure of absolute spelling ability), but these correlations were stronger. Specifically, raw WRAT-4 scores were strongly and positively correlated with the correct use of capitals for sentence-initial proper nouns, sentence-medial proper nouns, and sentence-initial common nouns, but were weakly and negatively correlated with the incorrect use of capitals for sentence-medial common nouns. Therefore, correct capitalisation use was more closely related to participants' absolute spelling ability than their age-corrected spelling ability.

Table 4*Correlations for Spelling Ability and Word Types*

Variable	Proper initial	Proper medial	Common initial	Common medial	WRATss	WRATrs
Proper initial	—					
Proper medial	.88***	—				
Common initial	.78***	.80***	—			
Common medial	-.08	-.12	-.08	—		
WRATss	.46***	.47***	.47***	-.28***	—	
WRATrs	.68***	.75***	.73***	-.24***	.69***	—

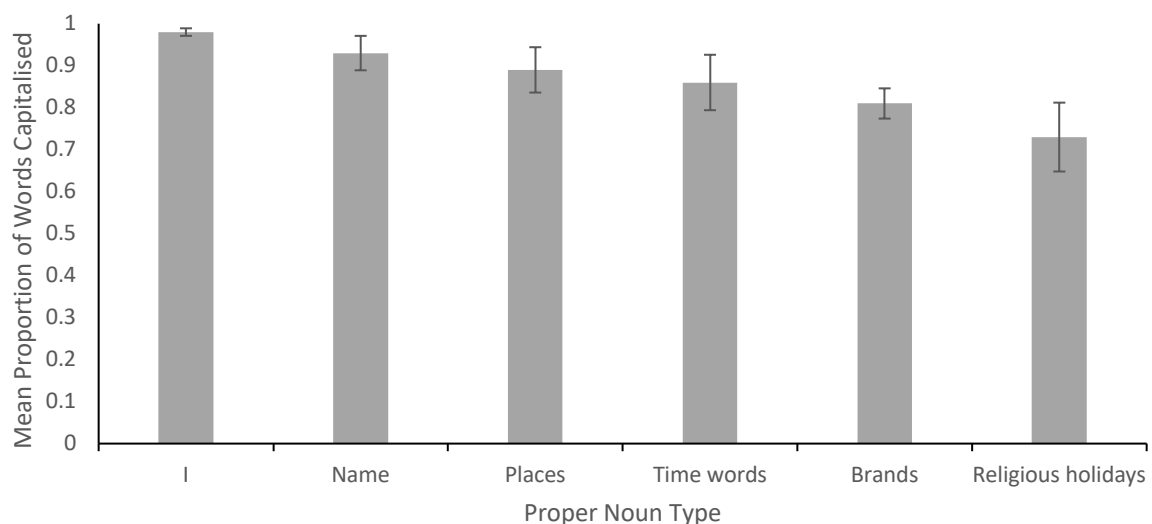
Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Correlations of importance are bolded.

Error Analysis

While it was not initially planned, we conducted an informal descriptive analysis of participants' response to proper nouns, to observe whether capitals were disproportionately used or avoided in any category. Figure 2 shows the mean proportion of words capitalised for different proper noun types. Capitals were omitted most often from religious holidays, but were used most of the time for brands, and for place and time words. Pronouns (both "I" and personal names) were almost always capitalised.

Figure 2

Mean Proportion (with SDs) Capitalised by Proper Noun Type



Discussion

The primary aim of the current study was to investigate the prediction derived from Integration of Multiple Patterns theory (IMP, Treiman & Kessler, 2014) that children's and adults' use of capitalisation should increase with the number of spelling cues supporting its use, and to examine how this varied with education level. We also aimed to examine whether spelling ability was associated with participants' correct use and avoidance of capitals. Our

results supported the hypothesis that, overall, spellers' use of capital letters would increase significantly with each additional cue. Specifically, participants used significantly more capitals for the two-cue word type condition than for both one-cue conditions, and more capitals for all of these than for the no-cue condition. This supports the predictions of IMP, but not those of traditional phase theories (e.g., Ehri, 2020; Gentry, 1982): phase theories suggest instead that a speller should show all-or-none performance, always using a rule correctly once it has been learned. In terms of the two single-cue conditions, our results showed that proper nouns were correctly capitalised significantly more often than were sentence-initial words, in accordance with our hypothesis. This finding suggests that, at least in the present task, word-level cues were stronger than sentence-level cues. Further, we attained partial support for our hypothesis that overall capital use would significantly increase with education level. While secondary and university students used capitals significantly more often than did primary students, there were no significant differences in the capitalisation rates of secondary students and university students.

Most importantly, we observed a significant interaction between word type and education level. Primary students showed a robust effect of number of cues: they capitalised the two-cue condition significantly more often than each of the one-cue conditions, and all of these more than the no-cue condition. In contrast, neither secondary nor university students showed a significant effect of cue number when it came to the cued conditions: the difference between their use of capitals for the two-cue and either one-cue condition did not reach significance, although both received significantly more capitals than the no-cue condition. Therefore, the interaction hypotheses were partially supported.

Finally, the results supported the hypothesis that absolute and standardised spelling abilities would be positively correlated with the correct use of capitals in cued conditions, and negatively correlated with the incorrect use of capitals in the uncued condition. Thus, the

correct use and avoidance of capitals was clearly linked to spelling skill, both in absolute terms and for one's age.

Changes in the Effect of Word Type Across Education Levels

IMP makes the general prediction that cue accumulation increases the likelihood of using a particular spelling, because the spelling is better supported with each additional cue (Treiman & Kessler, 2014). As the first test of IMP for capitalisation, our results supported the theory's claims overall: words with two cues were capitalised more often than those with one cue, and one-cue words more often than those with no cues. However, it is important to note that this main effect of word type concerned capitalisation *use*, rather than *correctness*: the three cued conditions required capitalisation, whereas the uncued condition did not, so capitalisation was incorrect for the latter. This also has implications for the main effect of education level, whereby secondary and university students capitalised more often overall than did primary students, but did not differ from one another. If older spellers are better at capitalising than younger spellers, they should both correctly apply *and* correctly omit capitals more often than do younger spellers. However, the literature is almost silent on adolescents' and adults' capitalisation abilities. Previous research has identified capitalisation as a common spelling error in adolescent writing (Lunsford & Lunsford, 2008; Wilcox et al., 2014), but has given no indication of the frequency at which these errors occur. To the researchers' knowledge, this is the first study to provide a systematic empirical report of adolescents' capitalisation abilities, and these findings can provide a useful baseline for further research. The current study also contributes to the sparse adult capitalisation research, to examine the extent to which children may be expected to improve in their capitalisation abilities over time.

Indeed, IMP makes no claim about the age at which spelling patterns, like capitalisation, are fully developed (Treiman & Kessler, 2014). We were interested to find that

on average, university participants were no better than primary school students at avoiding incorrect capitals (e.g., “Sam enjoys playing **Football**”). This finding implies that, at least in the present test format, the occasional tendency to capitalise unnecessarily persists with age. This finding cannot differentiate between theories, however. IMP makes no direct claim about how uncued capitalisation may change with education level (Treiman & Kessler, 2014), and phase models (e.g., Ehri, 2020; Gentry, 1982) would stipulate that all our spellers should have mastered the capitalisation skills and should thus all capitalise cued more than uncued conditions, regardless of education level.

Our results can be compared to those of Evans (2015), who observed that primary students (Grades 3-6) incorrectly capitalised sentence-medial common nouns twice as often (25-35% of the time) as did adults (10-15%). Although Evans (2015) did not analyse this comparison, this result suggests that adults are better at omitting capitals than are primary children. In contrast, as noted above, our participants incorrectly capitalised sentence-medial common nouns at a rate of 10% or lower, with no significant differences between education levels. These differing results were not due to spelling ability, as there was no difference in mean WRAT-4 spelling scores between Evans’ (2015) primary students ($M = 106.1$, as we calculated) and our primary students ($M = 106.2$). However, a difference in response page formatting may have contributed: Evans (2015) used a textbox for each target sentence, in which many target words were written at the left-hand side of the box. Given children’s early graphotactic knowledge of capitalisation (Treiman & Kessler, 2004), it may be that writing at the left of the box (the text position that is most often capitalised) encouraged more incorrect use of capitalisation than in the current study, in which uncued words always appeared towards the centre or right-hand side of the page (Appendix G).

The current study also found that education levels differed in their *correct* use of capitalisation. While primary students capitalised more often with two cues than with one,

secondary and university students performed at near-ceiling levels even with one cue. The latter finding cannot differentiate between theoretical claims. Again, IMP does not discuss how cue accumulation changes with education level. However, phase theories (e.g., Ehri, 2020; Gentry, 1982) would expect secondary and university students to perform at ceiling across cued conditions, because they have been taught the rules required to consistently capitalise correctly.

What phase theories cannot explain, however, is the primary students' stepwise pattern across cued conditions. This group thus serves as a critical test case for testing the theories' predictions. According to phase theories, children in Grades 3 to 6 should be able to capitalise just as well as older students, because they have been taught the same rules, and should therefore consistently apply capitals to both one- and two-cue conditions. Despite explicit teaching, however, primary students appear to still be learning where to use capitals, and accumulating cues helped them to surpass the threshold to choose to capitalise. For example, the primary students in the current study capitalised only 47% of sentence-initial common nouns (one cue), but 73% of sentence-initial proper nouns (two cues).

The pattern described above is consistent with Evans' (2015) findings. While Evans' adults correctly capitalised sentence-medial proper nouns (one cue) at ceiling, her primary students correctly capitalised only 60-75% of the time, in line with our primary students (64% for sentence-medial proper nouns). Since the primary students in the present study, and in Evans' (2015) study, capitalised proper nouns and sentence-initial words *most* of the time, phase theories (e.g., Ehri, 2020; Gentry, 1982) would predict that these children should be able to apply these capitalisation rules *all* the time, regardless of the number of cues. Clearly, this was not so: both Evans' (2015) findings and our own stand in direct contrast to the claims of phase theories. Therefore, the current study provides the first prospective evidence for IMP, that children do in fact benefit from accumulating capitalisation cues (Treiman &

Kessler, 2014), rather than applying capitalisation rules consistently, as suggested by traditional theories (e.g., Ehri, 2020; Gentry, 1982).

Regarding the one-cue conditions, sentence-medial proper nouns were capitalised more often overall than were sentence-initial common nouns. However, this effect was not uniform: primary students capitalised proper nouns more often than sentence-initial words, but secondary and university students did not differ in their capitalisation between the one-cue conditions. This finding would suggest that compared to older spellers, children pay more attention to word-level cues (i.e., noun status: proper or common) than to sentence-level cues (sentence position: initial or medial). One explanation is that, as noted in the introduction, proper nouns (should) have only one orthographic representation in memory, irrespective of sentence position (Treiman & Kessler, 2014): for example, “Fiji” should exist in the mental lexicon, but “fiji” should not. Therefore, there is only one feasible way to write a proper noun. In contrast, common nouns (should) have two orthographic representations (e.g., “Music”/“music”), and the capitalisation decision will depend on whether that word appears at the start of a sentence or sentence-medially.

IMP would acknowledge that the word-level cue is a self-contained one, requiring an understanding of only the word itself when deciding whether to capitalise it. In contrast, sentence-level cues rely on the knowledge that sentence-initial capitals are used to signify the beginning of a new idea, and on the consideration of the visual context of the whole sentence (Treiman & Kessler, 2014). Traditional spelling theories (e.g., Ehri, 2020; Gentry, 1982) have no explanation for why fewer capitalisation errors would be made for proper nouns than for sentence-initial words. Our findings align with the general patterns reported in historical studies of capitalisation use, even though their differences did not reach significance. Specifically, both Geoghegan and Fitzgerald’s (1935) findings and our reanalysis of Odom’s (1962) results showed that children omitted capitals numerically, although not significantly,

less often from proper nouns than from sentence-initial words. Therefore, our study provides the first empirical evidence that word-based cues may influence capitalisation more than sentence-level cues.

Spelling Ability

Spelling ability can be standardised to compare across age, or can be considered in its absolute form. We found that both standardised and absolute spelling abilities correlated positively with the correct use of capitals, and negatively with the correct avoidance of capitals, but the effects were stronger for absolute abilities. This suggests that capitalisation ability is determined more by achieving a particular level of spelling ability, rather than one's spelling ability relative to age-based peers. Therefore, as spelling ability improves, a speller may have more cognitive resources available to consider broader spelling functions (e.g., graphotactics) in their writing (Graham et al., 2002). Conversely, a speller may require fewer cognitive resources as they improve, because they can apply broader spelling rules more automatically (van Reybroeck et al., 2017). The relationship between spelling ability and capitalisation was of a similar strength for one- and two-cue conditions, suggesting that better spellers are more sensitive to cues in general, regardless of how many are present.

Error Analysis

We conducted a post hoc, informal analysis of errors after noticing that some proper nouns were capitalised considerably more or less frequently than others. The pronoun “I” was almost always capitalised, closely followed by personal names. In contrast, participants capitalised religious holidays (“Christmas” and “Easter”) less than three-quarters of the time. Odom (1962) also reported that children capitalised holidays less frequently than they capitalised “I”, time words, and names of people, but capitalised place names more frequently than these. These analyses demonstrate that researchers should consider the variation *within*, as well as *between* capitalisation cues. IMP acknowledges that statistical learning contributes

to the relative accessibility of a spelling pattern (Treiman & Kessler, 2014). Hence, pronouns (personal names and “I”) may be capitalised more often than other words simply because they are seen so often: personal names, especially, are a highly salient group of proper nouns with many category members. In contrast, most children would probably be familiar with only a few religious holiday category members (those of their own culture or environment), and therefore may find it harder to learn that these need capitalising. Both researchers and teachers should carefully consider the types of proper noun chosen for assessing children’s capitalisation knowledge.

Limitations and Future Directions

The current study had some limitations in its methodology and generalisability. As described above, our results suggest that primary students attend more to word-level capitalisation cues (proper nouns need a capital) than to sentence-level cues (sentence-initial words need a capital). However, this finding may have been at least partly exaggerated by the testing format. When we designed the study, we specifically chose a cloze (fill-in-the-blanks) dictation format over a full-sentence dictation format, to reduce the cognitive and physical effort of writing out entire sentences, particularly for the younger participants. However, the cloze format may have encouraged participants to process the target words at word level rather than at sentence level, by focusing their attention on one word at a time. This observation does not invalidate the current results, however; secondary and university students still performed at ceiling for sentence-initial common nouns.

This finding brings to light the impact that methodology can have, especially for younger spellers. Future research could investigate whether children still capitalise the word-level cue more often than the sentence-level cue when writing target words in full or partial sentences, but this method would have to be carefully administered to prevent participant fatigue. This could be achieved by having participants write only the first half of a sentence

(e.g., “**A**ustralians eat fruit for dessert”), thus encouraging them to consider the sentence context without having to write every word.

Where possible, we avoided using target words whose word-initial letter differs only in size between its upper- and lowercase forms (e.g., “V”/“v”, “S”/“s”). However, we included “Christmas” and “Sam”, as there were few words of appropriate length and familiarity to our youngest participants in their respective categories. This led to the need for independent rating, and then discussion, of some ambiguously capitalised target words, not only for “Christmas” and “Sam”, but also for target words starting with “F”/“f”, “J”/“j” and “M”/“m”. Therefore, despite our best efforts, it is possible that some words were incorrectly coded. We would suggest that future capitalisation research only uses target words whose word-initial letter differs markedly in shape between its upper- and lowercase forms, or has participants write the alphabet in upper- and lowercase at the end as a reference.

Finally, it is important to consider the limitations to the generalisability of this study. Our participants demonstrated a wide range of spelling abilities, but standardised WRAT-4 scores indicated that each group was slightly higher than average, but within the normal range. Therefore, it is possible that the general population, who would have slightly lower overall spelling ability, may follow the same pattern of capitalisation acquisition, but take longer to achieve ceiling-level performance (such as later in high school), or might never attain such high performance levels.

Implications and Conclusions

The current study has implications for both theory and education. Our results suggest that children capitalise better when multiple cues converge on the same answer, which provides the first prospective evidence for IMP. The current study also contributes to the development of IMP by providing an indication of the education level at which cue accumulation ceases providing additional benefit to a single capitalisation cue (namely, high

school), and by identifying spelling ability as a contributing factor to capitalisation ability. Further, the current study suggests that the all-or-none predictions of phase models (e.g., Ehri, 2020; Gentry, 1985) are too simplistic: despite having been taught to use capitals for proper nouns and for sentence-initial words, children do not consistently apply these rules. Future research could assess the claims of IMP for other spelling patterns that are not adequately addressed by traditional spelling theories, such as the cues of possession and letter omission for apostrophe use (Taggart & Wines, 2011), with the goal of understanding and improving children's decision-making in spelling.

Despite all explicit teaching of capitalisation occurring between Prep and Grade 2 (ACARA, 2015), participants in Grades 3 to 6 did not consistently apply capital letters to proper nouns and sentence-initial words: indeed, children responded better to word-level than sentence-level cues. Therefore, children's capitalisation abilities may be better consolidated if the school curriculum revisited these rules in these later primary grades. This could be achieved by explicitly drawing attention to proper nouns and sentence-initial words as cues to capitalisation to aid statistical learning of these patterns (Treiman & Kessler, 2014). Considering the present results, it may help students to conceptualise these rules as "cues". The current research points to the importance of assessing, and eventually intervening, to improve spelling abilities such as capitalisation. Research that improves our understanding of spelling acquisition does not just benefit theory, but also the practice of learning to spell.

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Appendix A

Sentence Sets

		Set A	Set B	PN Type
1	1	Boys in Fiji often climb trees.	Girls in Japan often wear hats.	Place name (country)
2	2	Japan is where girls often wear hats.	Fiji is where boys often climb trees.	
3	1	Gifts are given at Christmas .	Buns get eaten at Easter .	Holiday
4	2	Easter is when buns get eaten.	Christmas is when gifts are given.	
5	1	Pies are made a lot at Banjo’s bakeries.	Burgers are sold a lot at Nando’s restaurants.	Brand
6	2	Nando’s restaurants sell lots of burgers .	Banjo’s bakeries make lots of pies .	
7	1	Yesterday is when Meg had a meeting.	Tomorrow is when Jim has a party.	Person name
8	2	Jim has a party tomorrow .	Meg had a meeting yesterday .	
9	1	Music day at school is Friday .	Baking day at home is Monday .	Time word (weekday)
10	2	Monday is baking day at home.	Friday is music day at school.	
11	1	Novels are what I read at school.	Tigers are what I see at the zoo.	Pronoun
12	2	I see tigers at the zoo.	I read novels at school.	
13	1	Rain is coldest in July .	Leaves fall in April .	Time word (month)
14	2	April is when leaves fall.	July is when rain is coldest.	
15	1	Fruit is what Australians eat for dessert.	Bacon is what Americans eat for breakfast.	Country derivation
16	2	Americans eat bacon for breakfast.	Australians eat fruit for dessert.	
17	1	Apples are what Tasmania is famous for.	Bananas are grown a lot in Queensland .	Place name (state)
18	2	Queensland grows lots of bananas .	Tasmania is famous for its apples .	
19	1	Tennis is what Tom likes to play.	Football is what Sam enjoys playing.	Person name
20	2	Sam enjoys playing football .	Tom likes to play tennis .	
F1		Mum likes to swim in the sea on weekends .	<i>Both nouns, <sea> is a homophone.</i>	
F2		This cake has too much flour .	<i>Both nouns, homophone pair with F3.</i>	
F3		I gave my teacher a pretty flower .	<i>Both nouns, homophone pair with F2.</i>	
F4		The girl stroked the cat’s head.	<i>Both nouns.</i>	

Appendix B

University of Tasmania Ethics Approval Letter



17/05/2021

To: AssocProf Kemp

Project ID: 24076

Project Title: Grammar and spelling in children and adults

The above named project has been approved by the Tasmania Social Sciences Human Research Ethics Committee on the 17 May 2021.

Approval has been granted for the following documentation:

Submission Document Name	Submission Document File Name	Submission Document Type	Submission Document Date	Submission Document Version
GrammarSpellingStudy_Indep_Review	GrammarSpellingStudy_Indep_Review.pdf	EVIDENCE OF THE OUTCOME	15/03/2021	1
SpellingandGrammarSentences	SpellingandGrammarSentences.docx	OTHER PROJECT-RELATED DOCUMENTATION	26/03/2021	1
H0024076_REVISEDSpellingandGrammarStudyProjectDescription	H0024076_REVISEDSpellingandGrammarStudyProjectDescription.docx	PROTOCOL	11/05/2021	2
H0024076_REVISEDSpellingandGrammar_InfoConsentSheets	H0024076_REVISEDSpellingandGrammar_InfoConsentSheets.docx	PARTICIPANT INFORMATION AND CONSENT FORM	11/05/2021	2
H0024076_CoverLetterReviewResponse	H0024076_CoverLetterReviewResponse.docx	OTHER PROJECT-RELATED DOCUMENTATION	11/05/2021	1

The Tasmania Social Sciences Human Research Ethics Committee has provided approval for the project to be conducted at the following sites:

Online

Other

Schools in Hobart area who agree for their students to participate (plan to contact Rosny College, Rose Bay High, Clarence High, Lindsfame Primary, Bellerive Primary, Howrah Primary)

Please ensure that all investigators involved with this project have cited the approved versions of the documents listed within this letter and use only these versions in conducting this research project.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approvals of other bodies or authorities are required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

In accordance with the [National Statement on Ethical Conduct in Human Research 2007 \(updated 2018\)](#), it is the responsibility of institutions and researchers to be aware of both general and specific legal requirements, wherever relevant. If researchers are uncertain they should seek legal advice to confirm that their proposed research is in compliance with the relevant laws. University of Tasmania researchers may seek legal advice from Legal Services at the University.

All committees operating under the Human Research Ethics Committee (Tasmania) Network are registered and required to comply with the National Statement on the Ethical Conduct in Human Research 2007 (updated 2018).

Therefore, the Chief Investigator's responsibility is to ensure that:

- (1) All investigators are aware of the terms of approval, and that the research is conducted in compliance with the HREC approved protocol or project description.
- (2) Modifications to the protocol do not proceed until **approval** is obtained in writing from the HREC. This includes, but is not limited to, amendments that:
 - (i) are proposed or undertaken in order to eliminate immediate risks to participants;
 - (ii) may increase the risks to participants;
 - (iii) significantly affect the conduct of the research; or
 - (iv) involve changes to investigator involvement with the project.

Please note that all requests for changes to approved documents must include a version number and date when submitted for review by the HREC.

- (3) Reports are provided to the HREC on the progress of the research and any safety reports or monitoring requirements as indicated in NHMRC guidance.

Guidance for the appropriate forms for reporting such events in relation to clinical and non-clinical trials and innovations can be located under the ERM "Help Tab" in "Templates". All adverse events must be reported regardless of whether or not the event, in your opinion, is a direct effect of the therapeutic goods being tested.

- (4) The HREC is informed as soon as possible of any new safety information, from other published or unpublished research, that may have an impact on the continued ethical acceptability of the research or that may indicate the need for modification of the project.

- (5) All research participants must be provided with the current Participant Information Sheet and Consent Form, unless otherwise approved by the Committee.

- (6) This study has approval for four years contingent upon annual review. A Progress Report is to be provided on the anniversary date of your approval. Your first report is due on the anniversary of your approval, and you will be sent a courtesy reminder closer to this due date. Ethical approval for this project will lapse if a Progress Report is not submitted in the time

Appendix C

Department of Education Ethics Approval Letter

Department of Education
EDUCATION PERFORMANCE AND REVIEW

3/75 Campbell Street, Hobart
GPO Box 169, Hobart, TAS 7001 Australia



File: 2021-20 EPR0118656

24 June 2021

Nenagh Kemp
School of Psychological Sciences
University of Tasmania
Nenagh.kemp@utas.edu.au

Dear Nengah

He gave Rose a rose: How Children and Adults Use Capital Letter Cues

Thank you for the University of Tasmania's application to undertake research with the Department of Education. The Research Application Advisory Committee has decided that the above research study adheres to the guidelines established and that there is no objection to the study proceeding.

Condition:

- I. Researchers must comply with COVID-19 safety requirements, as applying in Tasmania and any additional or specific requirements advised by participating school(s).

Please note that you have been given approval to proceed at a general level, and not at individual school level. You will still need to seek permission from the principals of the schools to be involved in the study. Please provide them with the File number or a copy of this letter when approaching them for assistance.

A list of the schools where the principal has agreed to participate in the research needs to be forwarded to DoE, prior to, or soon after the commencement of the proposed activity.

A copy of your final report should be forwarded to Education Performance and Review, Department of Education, GPO Box 169, Hobart, 7001 or research@education.tas.gov.au at your earliest convenience and within six months of the completion of the research phase.

If you have further questions or concerns please contact John Kural on (03) 6165 5506.

Yours sincerely

Alex Tay
Director, Education Performance and Review

Appendix D

Principal and Parent/Caregiver Information and Consent Forms

Spelling and Grammar in Children and Adults

PARTICIPANT INFORMATION SHEET FOR PRINCIPALS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
 Contact **phone:** 6226 7534
 Contact **email:** nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

1. Invitation

Your school is invited to participate in a research study examining students' use of capital letters in sentences (at the start of words), and the grammatical "cues" that make children most likely to get capitals right. This study is being conducted by Emilia Hawkey, an Honours student in the School of Psychological Sciences, and she is supervised by Assoc Prof Nenagh Kemp.

2. What is the purpose of this study?

We're trying to find out which grammatical clues best help students work out when to use capitals in sentences, once they've been taught at school. We're looking at whether students use capitals more often when there are two grammatical "cues" in a sentence (e.g., proper noun at start of sentence), one cue (proper noun or start of sentence), or no cues (common noun in middle of sentence). This will help us work out at which age students make best use of cues and combinations of cues, and could ultimately lead to easier ways of teaching and learning this important aspect of writing.

3. How is the study being funded?

The study has no specific funding, although we will make use of a contribution from the School of Psychological Sciences to thank participating schools with a book voucher for their school library.

4. Why have I been invited to participate?

Your school is being invited to take part in this study because we are looking for students in government schools between Grades 3 and 12 who might be willing to participate in this short study. The Department of Education has given us approval to contact you, but your participation is entirely voluntary, and your choice to take part or not will have no consequences for your school.

5. What will I be asked to do?

Taking part would involve asking the teachers of Grade 3 to 12 classes if they would be willing to have the student researcher, Emilia, run a one-off spelling task in their classrooms, lasting about half an hour. We'd provide information and consent forms to be sent home, and we'd ask to publish a short description in the school newsletter. Students who returned consent forms (who also agree to take part themselves) would then take part in the study.

Emilia would give the students two spelling tasks: a standardised task that gives an estimate of students' general spelling skill, and a task in which students hear a set of 20 sentences spoken aloud, and write down two missing words per sentence, which do or do not require capitals. We would ask students to provide their age, gender, and whether they know any other languages, but we don't need to collect their names.

6. Are there any possible benefits from participation in this study?

Students may not experience direct benefits from participation, but once the study is over, teachers might find it useful to have a class discussion about the use and avoidance of capitals in different situations. More broadly, the results will advance our limited theoretical knowledge on the spelling

of grammatical patterns, and could ultimately lead to more efficient ways of teaching this important aspect of writing development.

7. Are there any possible risks from participation in this study?

There are no obvious risks from participating, except for the inconvenience of spelling a list of words.

8. What if I change my mind during or after the study?

If a student would like to stop participating during the study, they are welcome to stop writing the words at any time, with no consequence to them. Once the spelling sheets have been collected, however, the responses will be non-identifiable, and so if a student or parent wanted their individual data withdrawn, we wouldn't be able to remove it at that point.

9. What will happen to the data when this study is over?

Data will be non-identifiable. Paper data will be stored in locked filing cabinets in the University office of Chief Investigator Nenagh Kemp. Student researcher Emilia Hawkey will score the paper data and save the results in an electronic spreadsheet, stored on a University of Tasmania server, which is password-protected and only accessible to the researchers. Once the paper data has been transferred to electronic format, the paper sheets will be shredded. Most academic journals now require that non-identifiable data be made available upon request, and so we will keep the anonymous data stored for this purpose once we have published any results from the study. Parents will have the chance to sign to say whether they allow their child's data to be kept in this way, or to be destroyed five years after any publication.

10. How will the results of the study be published?

All data in this study are anonymous. Emilia will write up the results in her Honours thesis by October 2021, and we also hope to publish these results in an academic journal. We will provide a summary of the overall findings to the school before the end of the year.

11. What if I have questions about this study?

If you have any queries, concerns or issues with this study, please feel free to contact us:

- Assoc Prof Nenagh Kemp: email nenagh.kemp@utas.edu.au or phone 6226 7534
- Emilia Hawkey email at ehawkey@utas.edu.au

This study has been approved by the Tasmania Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, you can contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 2975 (SSHREC) or email ss.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0024076](#).

12. How can I agree to be involved?

If you would like your school to be involved, please sign the consent form provided.

Thank you for your time.

Spelling and Grammar in Children and Adults
PARTICIPANT CONSENT FORM FOR PRINCIPALS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
Contact **phone:** 6226 7534
Contact **email:** nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

By signing below, I confirm that I have read and understood the information sheet and in particular:

- I understand that my school's involvement will involve classes from Grades 3 to 12 being invited to do a half-hour spelling study in the classroom (at a time convenient to the school), focusing on the use of capital letters.
- I understand that participation involves the small risk that some students might feel frustrated by being asked to spell a list of words, but that they can stop at any time without consequence.
- Any questions that I have asked have been answered to my satisfaction
- I understand that all study data will be securely stored at the University of Tasmania.
- I understand that the results of the study will be published so that neither the school nor the children can be identified as participants
- I understand that my school's participation in this research is voluntary
- I understand that I am free to withdraw the school's participation at any time, without explanation or penalty
- I understand that I will not be able to withdraw my data after completing the research as it has been collected anonymously
- I agree for my school to participate in the study

Name	
Signature	
Date	

Statement by Researcher

☐

I have explained the project and the implications of participation in it to this volunteer and I believe that the consent is informed and that he/she understands the implications of participation.

Name	
Signature	
Date	

Spelling and Grammar in Children and Adults

PARTICIPANT INFORMATION SHEET FOR PARENTS/CAREGIVERS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
 Contact **phone:** 6226 7534
 Contact **email:** nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

1. Invitation

Your child is invited to participate in a study on students' use spelling and capital letters. This study is being conducted by Emilia Hawkey. She's an Honours student in the School of Psychological Sciences. Her supervisor is Assoc Prof Nenagh Kemp.

2. What is the purpose of this study?

We're trying to find out which grammatical clues best help students work out when to use capitals in sentences. These clues include whether a word is at the start of a sentence or not, or whether the word is a name, like "Daisy", or word like "daisy". This will help us work out when students make the best use of spelling clues. It could lead to better ways of teaching this important aspect of writing.

3. How is the study being funded?

The study has no specific funding. However, we will use a contribution from our University to thank schools with a book voucher for their school library.

4. Why have I been invited to participate?

We are looking for students in government schools between Grades 3 and 12 who might be willing to participate in this short study. The Principal has given us approval to contact you. Your participation is entirely voluntary. Your choice to take part or not will have no consequences for you or your child.

5. What will I be asked to do?

Taking part would involve a half-hour group session in your child's classroom. Student researcher Emilia would read out a series of words (in sentences) for students to write down.

Emilia would give two spelling tasks:

- A standardised task that gives an estimate of students' general spelling skill.
- A task in which students hear a set of 20 sentences spoken aloud, and write down two missing words per sentence.

We ask students to provide their age, gender, and whether they know any other languages. We don't need to collect their names.

6. Are there any possible benefits from participation in this study?

Students may not feel direct benefits from participation. But, once the study is over, teachers might find it useful to have a class discussion about spelling and capitals. The results will also help us learn more about spelling development and how to teach writing skills.

7. Are there any possible risks from participation in this study?

There are no obvious risks from participating. Some children might find it a nuisance to have to spell some words. No one but the researchers will see your child's responses. We will make it clear that they will find some words harder and some easier to spell.

8. What if I, or my child, change our mind during or after the study?

If a student would like to stop participating during the study, they are welcome to stop writing the words at any time. There is no consequence to them. Once the spelling sheets have been collected, though, the responses will be non-identifiable. So if you or your child wanted their own data withdrawn, we wouldn't be able to remove it at that point.

9. What will happen to the data when this study is over?

Data will be non-identifiable. Paper data will be stored in locked filing cabinets in the University office of Chief Investigator Nenagh Kemp. Student researcher Emilia Hawkey will score the paper data and save the results in an electronic spreadsheet. This is stored on a University of Tasmania server, which is password-protected and only accessible to the researchers. Once the paper data has been typed in electronically, we will shred the paper sheets. Most academic journals now require that (anonymous) data be made available upon request. We need to keep the data stored for this purpose once we have published any results from the study. You can sign below to say whether you allow your child's data to be kept in this way, or to be destroyed five years after any publication.

10. How will the results of the study be published?

All data in this study are anonymous. Emilia will write up the results in her Honours thesis by October 2021. We also hope to publish these results in an academic journal. We will provide a summary of the overall findings to the school before the end of the year.

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12. How can I agree to be involved?

If you would like your child to be involved, please sign the consent form provided and return to the school by [date].

Thank you for your time!

Spelling and Grammar in Children and Adults

PARTICIPANT CONSENT FORM FOR PARENTS/CAREGIVERS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
 Contact **phone:** 6226 7534
 Contact **email:** nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

By signing below, I confirm that I have read and understood the information sheet and in particular:

- I understand that my child's involvement will involve doing a half-hour spelling study in the classroom, focusing on the use of capital letters.
 - I understand that my child might feel frustrated by being asked to spell a list of words. However, they can stop at any time with no problems.
 - I'm satisfied that any questions that I have asked have been answered.
 - I understand that all electronic data will be securely stored at the University of Tasmania for five years from the publication of study results. (Paper data will be shredded as soon as it's typed up electronically.) It will then be destroyed unless I give permission for it to be used to support other research in the future
- ☐ I agree that my child's study data can be used for this particular project (and destroyed five years after any publication)
- ☐ I agree that my child's anonymous study data can be shared and used for future research projects in the same general area of this research (i.e., not destroyed five years after any publication)
- I understand that the results of the study will be published so that my child cannot be identified as a participant
 - I understand that my child's participation in this research is voluntary
 - I understand that I can withdraw my child from participation, without explanation or penalty
 - I understand that I won't be able to withdraw my child's data after they have completed the study, as it will be anonymous
 - I agree for my child to participate in the study

Parent Name	
Child Name	

Signature	
Date	

Statement by Researcher☐

The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Name	
Signature	
Date	

Appendix E

School Participant Information and Consent Forms

Information Sheet and Consent Sheet for Primary School Students

Children's spelling study

Would you like to help with our study on how children spell? Some of the words are easy, and some are a bit harder.

If you decide to help with this study, a university student called Emilia will come to your classroom. She will ask you and other students to write down some words. She will read them out for you. You will also write down your age, gender, and whether you speak any other languages.

Only Emilia and her teacher, Nenagh, will see your spellings. Your teacher won't see them. It doesn't matter if you don't know how to spell all the words. Just do your best!

We will be pleased if you would like to be in our study. But if you don't want to, you can just say "No, thank you". If you start and then want to stop, you can just say so. You don't need to tell us why. If you don't like something about the study, please let your teacher know. Your teacher can tell the people at the University.

Thank you for your help!
Nenagh Kemp

Emilia Hawkey

You can keep this sheet for yourself. You will get another sheet too, just the same.

If you want to help with the study, you can write your name at the bottom.

If you don't want to help with the study, you don't have to write your name.

- I understand what this letter says about choosing to help with this study of children's spelling.
- I have asked any questions I had about it.
- I agree to help with this study.

Name: _____

Researcher's signature: This participant has understood and agrees to help:

Date: _____

Information Sheet for High School Students

School spelling study

You are invited to help with our study on how school students spell different words. Some are easy, and some are a bit harder.

If you decide to take part this study, a university student called Emilia will come to your classroom, to work with the students in your class who have permission from their parents, as long as the students also agree to take part. She will ask you to spell some words that she reads out for you. You will also need to write down your age, gender, and whether you speak any other languages.

Only Emilia and her university supervisor, Nenagh, will see your spellings. Your teacher won't see them, and it doesn't matter if you don't know how to spell all the words – just do your best!

We will be pleased if you would like to be in this study. But even if your parents/caregivers say you can take part, if you don't want to do it, or if you start and then want to stop, then you can just say so. You don't need to tell us why.

If there's something you don't like about the way the study is being run, you can contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 2975 (SSHREC) or email ss.ethics@utas.edu.au. You can say it's about study number H0024076.

Thank you for your help!

Nenagh Kemp

Emilia Hawkey

You can keep this sheet for yourself. You will get another sheet too, just the same.

If you want to help with the study, you can write your name at the bottom.

If you don't want to help with the study, you don't have to write your name.

- I understand what this letter says about choosing to help with this study of children's spelling.
- I have asked any questions I had about it.
- I agree to help with this study.

Name: _____

Researcher's signature: This participant has understood and agrees to help:

Date: _____

Spelling and Grammar in Children and Adults

PARTICIPANT INFORMATION SHEET FOR YEAR 11 AND 12 STUDENTS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
 Contact **phone:** 6226 7534
 Contact **email:** nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

1. Invitation

You are invited to participate in a research study examining the use of spelling patterns in adults and children. This study is being conducted by Emilia Hawkey, an Honours student in the School of Psychological Sciences, University of Tasmania. She is supervised by Assoc Prof Nenagh Kemp.

2. What is the purpose of this study?

We're trying to find out whether the cues that adults use in their spelling are the same as, or different from, the patterns of cues that best help young people write words in sentences appropriately.

3. How is the study being funded?

The study has no specific funding.

4. Why have I been invited to participate?

All students in your class are invited to take part in this study, as long as their parents/caregivers agree. You can choose whether to take part or not take part, and your choice will have no consequences for your progress or marks.

5. What will I be asked to do?

You will be asked to take part in a spelling study that lasts approximately half an hour. You will listen to the student researcher read out a series of sentences, and write down two words from each sentence. You will also spell a series of spoken words of increasing difficulty. We ask you to provide your age, gender, and whether you speak a language other than English, but the study is anonymous, so you don't need to provide your name. Only the researchers will see your spellings, and your classmates and teacher won't.

6. Are there any possible benefits from participation in this study?

This study provides an experience in how we might test something as basic as spelling knowledge. Participating might help you focus more on your own writing/spelling strategies.

7. Are there any possible risks from participation in this study?

There are no specific risks from participating, except for the inconvenience of spelling a list of words.

8. What if I change my mind during or after the study?

If you would like to stop participating during the study, you may stop at any time, with no problems at all. You don't need to tell us you've stopped, and there will be no consequences for you if you do. Once you have handed in your response, however, the responses will be non-identifiable, and so we wouldn't be able to remove your data at that point.

9. What will happen to the data when this study is over?

Data will be non-identifiable and saved on a University of Tasmania server, which is password-protected and only accessible to the researchers. Once we have typed in the paper data, that will be shredded. Most academic journals require that non-identifiable data be made available upon request, and so we will keep the data stored for this purpose once we have published any results from the study. You will get to decide whether you are happy to have your anonymous data kept in this way, or whether you want it to be destroyed 5 years after any publication.

10. How will the results of the study be published?

All data in this study are anonymous. Student researcher Emilia Hawkey will write up the results in her Honours thesis by October 2021, and we also hope to publish these results in an academic journal. We will provide a summary of the overall findings to your class teacher to share with you, before the end of the year.

11. What if I have questions about this study?

If you have any queries, concerns or issues with this study, please feel free to contact us:

- Assoc Prof Nenagh Kemp: email nenagh.kemp@utas.edu.au or phone 6226 7534
- Emilia Hawkey email at ehawkey@utas.edu.au

This study has been approved by the Tasmania Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, you can contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 2975 (SSHREC) or email ss.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0024076](#).

12. How can I agree to be involved?

You can take part once you've completed and signed the consent form.

Thank you for your time!

Spelling and Grammar in Children and Adults
PARTICIPANT CONSENT FORM FOR YEAR 11 AND 12 STUDENTS

Research team: **Chief Investigator:** Assoc Prof Nenagh Kemp
Associate Investigator: Emilia Hawkey, Honours student
Affiliation: School of Psychological Sciences, University of Tasmania
Contact phone: 6226 7534
Contact email: nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

By signing below, I confirm that I have read and understood the information sheet and in particular:

- I understand that my involvement will mean doing a half-hour spelling study in the classroom.
 - I understand that participation has no specific risk. I might feel frustrated by being asked to spell a list of words, but I can stop at any time without any consequences for me.
 - Any questions that I have asked have been answered to my satisfaction
 - I understand that all study data will be securely stored at the University of Tasmania for five years from the publication of study results, and will then be destroyed unless I give permission for it to be used to support other research in the future. I understand that paper data will be shredded as soon as it has been transferred to electronic format.
- ☐ I agree that my data can be used for this particular project (and destroyed five years after any publication)
- ☐ I agree that my data can be shared and used for future research projects in the same general area of this research (i.e., and not destroyed five years after any publication)
- I understand that the results of the study will be published so that I cannot be identified as a participant
 - I understand that my participation in this research is voluntary
 - I understand that I am free to stop participating at any time during the task, without explaining why, and with no consequence for me
 - I understand that I will not be able to withdraw my data after I have completed the study, as it has been collected anonymously
 - I agree to participate in the study

Name	
Signature	
Date	

Statement by Researcher

☐

The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate in this project.

Name	
Signature	
Date	

Appendix F

University Participant Information and Consent Forms

Spelling and Grammar in Children and Adults

PARTICIPANT INFORMATION SHEET FOR THIRD-YEAR UNIVERSITY STUDENTS

Chief Investigator: Assoc Prof Nenagh Kemp

Affiliation: School of Psychological Sciences, University of Tasmania

Contact phone: 6226 7534

Contact email: nenagh.kemp@utas.edu.au or ehawkey@utas.edu.au

1. Invitation

As part of the practical component of Psychology of Language, you will be asked to complete two spelling tasks. This will provide the data for your research report for this unit. Participation should take about 30 minutes.

2. What is the purpose of this study?

The study aims to assess the way that adults use certain grammar-based rules to spell simple words. (We'll talk more about these rules once you've done the task.) We'll also look at whether people's tendency to use these rules is related to their general spelling skill.

3. How is the study being funded?

The study has no specific funding.

4. Why have I been invited to participate?

All Psychology of Language students are asked to participate as part of normal class activities. However, you will also be invited to allow your (non-identifiable) data to be included in a later publication, should it eventuate. Whether or not you choose to have your data included in this way will be entirely anonymous (i.e., teaching staff will not know who has/hasn't agreed), and will have no consequences for your marks or progress in this unit.

5. What will I be asked to do?

You will be asked to take part in an in-class spelling study that lasts approximately half an hour. You will listen to a series of sentences, and write in two words from each sentence. You will also complete a standardised spelling task that presents a series of spoken words of increasing difficulty. We ask you to provide your age, gender, and whether you speak a language other than English, but the study is anonymous, so you don't need to provide your name.

6. Are there any possible benefits from participation in this study?

In Psychology of Language you will learn about a number of ways of testing linguistic knowledge, and this study provides experience in participating in and interpreting the results of such a study. Participating might help you focus more on your own writing/spelling strategies, and at a broader level, your responses will contribute to the sparse literature on the spelling of grammatical patterns.

7. Are there any possible risks from participation in this study?

There are no specific risks from participating, except for the inconvenience of spelling a list of words.

8. What if I change my mind during or after the study?

When you get to the end of the study, you can indicate whether you agree to having your non-identifiable data included in any research publication that may later arise. If you would like to stop participating during the study, you may withdraw at any time, with no consequence. Once you have submitted your response, however, the responses will be non-identifiable, and so we wouldn't be able to remove your data at that point.

9. What will happen to the data when this study is over?

Data will be non-identifiable. The responses will be coded anonymously by class members as part of a self-directed practical, but the demographic information (age, gender, language) will not be visible during this process. After coding, paper copies will be shredded. The coded data will be saved on a University of Tasmania server, which is password-protected and only accessible to the researchers. Most academic journals require that non-identifiable data be made available upon request, and so we will keep the data stored for this purpose once we have published any results from the study.

10. How will the results of the study be published?

All data in this study are anonymous, and will be used for this unit's research report. It is hoped that the results will also eventually be published in an academic journal.

11. What if I have questions about this study?

If you have any queries, concerns or issues with this study, please feel free to contact the CI:

- Assoc Prof Nenagh Kemp: email nenagh.kemp@utas.edu.au or phone 6226 7534

This study has been approved by the Tasmania Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, you can contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 2975 (SSHREC) or email ss.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. You will need to quote [H0024076](#).

12. How can I agree to be involved?

Submitting your response confirms your consent for the information you have provided to be used in this study.

Thank you for your time!

Spelling and Grammar in Children and Adults

PARTICIPANT CONSENT FORM FOR THIRD-YEAR UNIVERSITY STUDENTS

Chief Investigator: Assoc Prof Nenagh Kemp, School of Psychological Sciences, UTAS

Contact **phone:** 6226 7534; Contact **email:** nenagh.kemp@utas.edu.au

By signing below, I confirm that I have read and understood the information sheet and in particular:

- I understand that my involvement will mean doing a half-hour spelling study in class.
- I understand that participation has no specific risk. I might feel frustrated by being asked to spell a list of words, but I can stop at any time without any consequences for me.
- Any questions that I have asked have been answered to my satisfaction
- I understand that all study data will be securely stored at the University of Tasmania for five years from the publication of study results, and will then be destroyed unless I give permission for it to be used to support other research in the future.
- ☐ I understand that my data will be used for this in-class project
- ☐ I agree that my data can be included in a possible future publication
- ☐ I agree that my data can be shared and used for future research projects in the same general area of this research
- I understand that the results of the study will be used and/or published so that I cannot be identified as a participant
- I understand that my participation in this study is voluntary
- I understand that I am free to stop participating at any time during the task, without explaining why, and with no consequence for me
- I understand that I will not be able to withdraw my data after I have completed the study, as it has been collected anonymously
- I agree to participate in the study

Name	
Signature	
Date	

Statement by Researcher

☐ The participant has received the Information Sheet where my details have been provided so participants have had the opportunity to contact me prior to consenting to participate.

Name	
Signature	

Date	
------	--

Appendix G

Participant Answer Sheets (Grades 3–10, Grade 11–University)

I am in Grade _____.

I am _____ years and _____ months old.

I am a boy / girl / other / no answer

My first language is English: Yes / No

If no: I also speak _____.

I can read/write in that language: Yes, very well / Yes, a bit / No

1. _____ is _____ day at home.
2. _____ are what _____ read at school.
3. _____ are made a lot at _____ bakeries.
4. I gave my _____ a pretty _____.
5. _____ is what _____ eat for dessert.
6. _____ is coldest in _____.
7. _____ are given at _____.
8. _____ is when _____ fall.
9. _____ in _____ often climb trees.
10. _____ eat _____ for breakfast.
11. Mum likes to swim in the _____ on _____.
12. _____ restaurants sell lots of _____.
13. _____ day at school is _____.
14. _____ is what _____ likes to play.
15. _____ are what _____ is famous for.
16. _____ is when _____ had a meeting.

17. _____ enjoys playing _____.
18. This _____ has too much _____.
19. _____ is where _____ often wear hats.
20. The _____ stroked the _____ head.
21. _____ see _____ at the zoo.
22. _____ grows lots of _____.
23. _____ has a party _____.
24. _____ is when _____ get eaten.

1	13	25
2	14	26
3	15	27
4	16	28
5	17	29
6	18	30
7	19	31
8	20	32
9	21	33
10	22	34

11	23	35
12	24	36

Grade: _____

Gender: Male/Female/Prefer to self-describe as _____/Prefer not to say

Is English your first language? Yes/No If no: I also speak _____.

I can also read/write in that language Yes, very well / Yes, a bit / No

1. _____ is _____ day at home.
2. _____ are what _____ read at school.
3. _____ are made a lot at _____ bakeries.
4. I gave my _____ a pretty _____.
5. _____ is what _____ eat for dessert.
6. _____ is coldest in _____.
7. _____ are given at _____.
8. _____ is when _____ fall.
9. _____ in _____ often climb trees.
10. _____ eat _____ for breakfast.
11. Mum likes to swim in the _____ on _____.
12. _____ restaurants sell lots of _____.
13. _____ day at school is _____.
14. _____ is what _____ likes to play.
15. _____ are what _____ is famous for.
16. _____ is when _____ had a meeting.
17. _____ enjoys playing _____.
18. This _____ has too much _____.

19. _____ is where _____ often wear hats.
20. The _____ stroked the _____ head.
21. _____ see _____ at the zoo.
22. _____ grows lots of _____.
23. _____ has a party _____.
24. _____ is when _____ get eaten.

10	21	32
11	22	33
12	23	34
13	24	35
14	25	36
15	26	37
16	27	38
17	28	39
18	29	40
19	30	41
20	31	42

Appendix H

Post Hoc Tests for Main Effect of Word Type

Comparison		Mean difference	Standard error	df	<i>t</i>	<i>p</i> _{Tukey}
Word type	Word type					
Proper initial	Proper medial	0.05	0.01	202	6.34	< .001
	Common initial	0.14	0.01	202	9.32	< .001
	Common medial	0.81	0.02	202	47.17	< .001
Proper medial	Common initial	0.09	0.01	202	6.09	< .001
	Common medial	0.76	0.02	202	45.25	< .001
Common initial	Common medial	0.67	0.02	202	29.41	< .001

Appendix I

Post Hoc Tests for Interaction of Word Type and Education Level

Word Type	Education Level	Word Type	Education Level	Mean Difference	Standard Error	df	<i>t</i>	<i>p</i> _{tukey}
Proper initial	Primary	Proper initial	Secondary	−0.23	0.03	202	−7.21	< .001
			University	−0.26	0.03	202	−8.61	< .001
		Proper medial	Primary	0.09	0.01	202	7.42	< .001
			Secondary	−0.20	0.03	202	−6.62	< .001
			University	−0.24	0.03	202	−8.23	< .001
		Common initial	Primary	0.27	0.03	202	10.72	< .001
			Secondary	−0.15	0.04	202	−3.66	.017
			University	−0.20	0.04	202	−5.22	< .001
		Common medial	Primary	0.63	0.03	202	20.81	< .001
			Secondary	0.65	0.03	202	21.37	< .001
			University	0.67	0.03	202	23.50	< .001
	Secondary	Proper initial	University	−0.03	0.03	202	−0.86	.999

	Proper medial	Primary	0.32	0.03	202	10.41	< .001
		Secondary	0.03	0.01	202	1.91	.752
		University	−0.01	0.03	202	−0.29	1.000
	Common initial	Primary	0.50	0.04	202	12.10	< .001
		Secondary	0.08	0.03	202	2.82	.180
		University	0.03	0.04	202	0.77	1.000
	Common medial	Primary	0.86	0.03	202	28.33	< .001
		Secondary	0.88	0.03	202	27.80	< .001
		University	0.90	0.03	202	30.83	< .001
	University Proper medial	Primary	0.35	0.03	202	12.13	< .001
		Secondary	0.05	0.03	202	1.74	.847
		University	0.02	0.01	202	1.54	.926
University	Common initial	Primary	0.53	0.04	202	13.24	< .001
		Secondary	0.10	0.04	202	2.45	.376
		University	0.06	0.02	202	2.44	.383
	Common medial	Primary	0.89	0.03	202	31.55	< .001

Proper medial	Primary	Proper medial	Secondary	0.90	0.03	202	31.47	< .001	
			University	0.92	0.03	202	33.87	< .001	
		Common initial	Secondary	Secondary	−0.30	0.03	202	−9.92	< .001
				University	−0.33	0.03	202	−11.84	< .001
			Primary	Primary	0.18	0.03	202	6.95	< .001
				Secondary	−0.25	0.04	202	−5.95	< .001
	Common medial		University	University	−0.29	0.03	202	−7.80	< .001
				Primary	0.54	0.03	202	18.01	< .001
		Secondary	Secondary	Secondary	0.55	0.03	202	18.87	< .001
				University	0.57	0.03	202	20.95	< .001
			Proper medial	University	−0.03	0.03	202	−1.18	.990
				Common initial	Primary	0.48	0.04	202	11.70
	Common medial		Secondary	0.05	0.03	202	1.85	.789	
			University	0.01	0.04	202	0.13	1.000	
Primary			0.83	0.03	202	28.45	< .001		
Secondary			0.85	0.03	202	27.44	< .001		

			University	0.87	0.03	202	31.09	< .001
Common initial	University	Common initial	Primary	0.51	0.04	202	12.99	< .001
			Secondary	0.08	0.04	202	2.06	.654
			University	0.04	0.02	202	1.65	.887
		Common medial	Primary	0.87	0.03	202	31.85	< .001
			Secondary	0.88	0.03	202	31.75	< .001
			University	0.91	0.03	202	33.75	< .001
	Primary	Common initial	Secondary	−0.43	0.05	202	−8.56	< .001
			University	−0.47	0.05	202	−10.14	< .001
		Common medial	Primary	0.36	0.04	202	8.80	< .001
			Secondary	0.37	0.04	202	9.21	< .001
			University	0.39	0.04	202	10.08	< .001
Secondary	Common initial	University	−0.05	0.05	202	−0.94	.999	
	Common medial	Primary	0.78	0.04	202	19.04	< .001	
		Secondary	0.80	0.04	202	19.02	< .001	
		University	0.82	0.04	202	20.41	< .001	

Common medial	University	Common medial	Primary	0.83	0.04	202	22.40	< .001
			Secondary	0.85	0.04	202	22.57	< .001
			University	0.87	0.04	202	23.80	< .001
	Primary	Common medial	Secondary	0.02	0.03	202	0.56	1.000
			University	0.04	0.03	202	1.42	.958
	Secondary	Common medial	University	0.02	0.03	202	0.80	1.000