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External non-linguistic cues influence language selection during a forced choice task

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Research Article

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Abstract

This study investigated the effect of external non-linguistic cues on language selection in bilinguals. Participants viewed photographs and stated in which language they would speak to the individuals in those photographs via a button press. These images were manipulated such that external cues (the 'speak Welsh' logo, presented in the form of a poster or a lanyard) were present or absent. Participants responded faster and selected Welsh as their language of choice more often in trials that contained a language cue than in trials in which a language cue was absent. Furthermore, trials containing a lanyard had a greater effect on participant performance than trials containing a poster. These results suggest that external cues can influence language selection in bilinguals, and that the perceived reliability of the cue can modulate this effect. These findings have implications for the language selection literature and could inform the development of future language use interventions.

Introduction

Proficient bilinguals can switch between and use both languages with ease in varying situations, further supporting the suggestion that both languages are simultaneously co-active (e.g., Grainger & Dijkstra, 1992; van Heuven, Dijkstra & Grainger, 1998). Despite this co-activation, bilingual individuals can produce monolingual utterances, and can adapt the language spoken to be contextually appropriate. To account for this apparent contradiction, a mechanism should be identified through which a lexical candidate from the language of operation must be selected, rather than its co-active alternative in the other language (see Kroll, Bobb, Misra & Guo, 2008 for a discussion). In order to identify such a mechanism, Green (1998) proposed the Inhibitory Control (IC) model, in which lexical items stored in a language nonselective lexicon are associated with language tags. In this model, task schemas strengthen the activation of lexical items in the language of operation, and inhibit the activation of lexical items in the non-operational language, via language tags. In theory, activation of these schemas could be influenced by external cues (e.g., language context; bottom-up process) or by top-down processes such as language preference (e.g., Green, 2018; de Bruin & Martin, 2022).

The influence of external cues is further supported by the suggestion that bilinguals may operate in specific 'language modes' (Grosjean, 1998, 2008). These modes can be best visualised along a continuum, ranging from a completely monolingual mode (in which a bilingual activates the representations of only one language) to a completely bilingual mode (in which a bilingual activates the representations of both languages). The extent to which the representations of each language are activated can be influenced by a number of factors (e.g., general context, stimuli used, experimental task; Grosjean, 2013), and Li, Yang, Scherf and Li (2013) argued that such external cues could be linguistic or non-linguistic in nature.

Recent studies have tested the assumptions of such language selection mechanisms using both linguistic and non-linguistic cues. Studies investigating the influence of linguistic cues (e.g., bilingual tasks; use of cognates) on language selection have typically focused on language co-activation and have generated conflicting results. Whilst some studies indicate that the extent to which co-activation occurs is dependent on the language context of the task (e.g., Dijkstra & van Heuven, 2002), others imply that co-activation is not modulated by linguistic constraints such as predictability and sentence context (e.g., Lagrou, Hartsuiker & Duyck, 2013). Thus, the relative influence of linguistic cues on language selection is currently unclear.

More recently, focus has shifted to the impact of non-linguistic cues (e.g., a poster or the face of an interlocutor associated with a particular language) on language comprehension and selection, with most studies highlighting the priming impact of such cues (see Hartsuiker, 2015 for a brief review). For example, Grainger, Declerck and Marzouki (2017) examined the influence of flags on word recognition in French–English bilinguals. They argued that the French and UK flags were strongly associated with the French and English languages, respectively, and investigated whether these flag-language associations could impact participant performance in a lexical decision task. Participants were presented with a series of letter strings and were

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instructed to indicate whether the letter strings were words (in either English or French) or not. The letter strings were either superimposed on an image of the French or UK flag (experiment 1) or presented immediately after an image of the flag appeared (experiment 2), and participants were told to ignore the flags when completing the task. They reported faster response times to congruent trials (i.e., trials in which the flag matched the language of the letter string) compared to incongruent trials (i.e., trials in which the flag did not match the language of the letter string). The authors concluded that non-linguistic cues strongly associated with a specific language can influence language selection by automatically activating language membership information during comprehension.

Woumans, Martin, Vanden Bulcke, Van Assche, Costa, Hartsuiker and Duyck (2015) investigated whether the face of an interlocutor could influence language selection in bilinguals. They conducted a production task in which participants were firstly familiarised with individuals via Skype. These individuals spoke to the participants in one of their two languages, thus creating a language expectation. After the initial exposure phase, participants completed a noun-verb association task: the nouns were produced by faces that were either familiar (interlocutors from the exposure phase) or unfamiliar (interlocutors that were not included in the exposure phase). The words produced by the familiar faces were manipulated such that they were congruent (the words were produced in the same language used in the familiarisation stage) or incongruent (the words were produced in a different language than was used in the familiarisation stage) with the participants' language expectation. They found that participants initially responded faster to congruent trials than to incongruent trials, indicating that the faces served as a cue for language selection. Interestingly, this facilitation effect disappeared in later trials, which suggests that the inclusion of incongruent trials eradicated the reliability of faces as language cues. Thus, this research not only demonstrates the effectiveness of faces as primes for language selection, but also highlights the importance of cue reliability during language selection processes (see Li, Yang, Scherf & Li, 2013; Molnar, Ibáñez-Molina & Carreiras, 2015, for similar findings).

Visual cues linked to languages, as well as task-irrelevant cues, can also prime language selection (Bhatia, Prasad, Sake & Mishra, 2017). In a series of experiments, Bhatia et al. asked participants to produce the names of line drawings in either Hindi or English. During the study, participants learned to associate a colour (red or green) with a language (English or Hindi). At the start of each trial, participants saw a cartoon figure waving to either a red or a green square, before being presented with a task instruction or an image to name. Participants were told that the cartoon was random and irrelevant to the task. They found that participants' language selection was influenced by the colour selected by the cartoon at the start of the trials and concluded that task-irrelevant cues can influence language selection (see also de Bruin & Martin, 2022; Kapiley & Mishra, 2019). Whilst it appears that non-linguistic cues associated with particular languages can influence language selection, the extent to which this effect occurs in real-life situations is currently unclear.

Here, we expand on the work of Bhatia et al., to investigate whether specific logos associated with a language can encourage the use of one language over the other in a bilingual setting. In 2005, the Welsh Language Board established the 'Iaith Gwaith' (working Welsh) scheme to supply Welsh businesses and services with resources to promote the use of Welsh within the workplace. These resources include lanyards, badges, and posters, all of which contain an orange speech bubble to indicate that the individual can speak Welsh. The scheme is well-established within Wales, with over 50,000 resources being distributed on an annual basis (https://www.welshlanguagecommissioner.wales/your-rights/iaith-gwaith), and a similar scheme was launched in Scotland in 2019 to promote the use of Gaelic (https://www.gaidhlig.scot/en/the-cleachdi-initiative/). However, despite the popularity of the scheme, the effectiveness of these products (i.e., their impact on language use) has not been evaluated in an empirical way. Thus, the aim of the current study is to investigate the impact of an external, non-linguistic cue (the Iaith Gwaith logo) on language selection in Welsh–English bilinguals.

We presented participants with photographs of individuals in a reception setting, and asked participants to indicate the language that they would speak to these individuals, by means of a button press. The photographs were manipulated to create four experimental conditions: the first included a lanyard as a language cue, the second included a poster as a language cue, the third included both a lanyard and a poster as language cues, whilst the fourth did not contain any language cue. If the 'Iaith Gwaith' logo works as an effective cue for language selection, participants should choose to speak Welsh more when presented with photographs containing the logo, than when presented with photographs in which the logo is absent. Furthermore, their response times should be faster in conditions where a language cue is present than conditions where the language cue is absent.

We also anticipated an effect of the type of language cue presented. Posters of the Iaith Gwaith logo placed in a public space suggest that some individuals working within that space can speak Welsh. However, they do not indicate that all individuals speak Welsh, nor do they specify which individuals can speak the language. As such, a degree of uncertainty remains when using posters as cues, and we speculate that this language cue may be perceived as less reliable than others. In contrast, lanyards are used to identify specific individuals who speak Welsh, providing the customer with a degree of certainty around their language options. For this reason, we speculate that the lanyard may be perceived as a more reliable language cue than the poster. Given the impact of cue reliability on language selection (e.g., Woumans et al., 2015), we predicted that participants would perceive the lanyard as a more reliable language cue, and as such would choose to speak Welsh more in this condition than in the poster condition. The effect of reliability should also be observed in response times, with faster responses in the lanyard condition relative to the poster condition.

Methods

Participants

Forty-eight Welsh–English bilinguals participated in this study. Of this sample, six participants were excluded as they recognised a high number of the individuals presented as stimuli (as measured by a recognition task described below). Thus, 42 highly proficient bilingual participants (11 male, 31 female; $M_{age} = 22.05$ years; $SD = 6.79$) were included in the final analysis. All participants possessed normal or corrected to normal vision. Ethical approval was obtained from Bangor University Psychology Ethics Committee, and all participants provided written consent.

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Of our sample, four participants defined English as their native language, three defined both Welsh and English as their native languages, with the remainder (35) defining Welsh as their native language. When asked which languages were spoken at home, 16 participants stated only Welsh, 24 stated that both Welsh and English were spoken at home, and 2 participants stated that English was used at home, with Welsh being learnt at School. All participants reported that they had learnt English from an early age ($M = 3.62$; $SD = 2.58$). The four participants who defined English as their native language reported that they learnt Welsh from an early age ($M = 3.3$; $SD = 3.01$). We also asked participants to rate their reading and writing proficiency, their conversational fluency, and their speech comprehension in both languages on a 10-point scale, with higher ratings reflecting greater proficiency. An overall proficiency score was calculated for each language by averaging these ratings. These revealed that, whilst participants scored themselves as proficient in English ($M = 8.37$, $SD = 1.29$), they rated themselves as more proficient in Welsh ($M = 9.10$, $SD = 1.21$; $p < .001$). Further investigations revealed that proficiency scores did not differ in terms of reading proficiency in English ($M = 8.71$, $SD = 1.53$) and Welsh ($M = 8.88$, $SD = 1.90$), or in terms of writing proficiency in English ($M = 8.29$, $SD = 1.42$) and Welsh ($M = 8.45$, $SD = 1.88$). However, participant ratings differed significantly in terms of their conversational fluency in English ($M = 8$, $SD = 2.02$) and Welsh ($M = 9.64$, $SD = 0.62$; $p < .001$) and in terms of their speech comprehension ability in English ($M = 8.48$, $SD = 1.76$) and Welsh ($M = 9.43$, $SD = 1.25$; $p = .003$).

Materials and design

The photographs of 36 Welsh–English bilinguals (15 male, 21 female; $M_{age} = 40.22$ years) were used as the experimental stimuli. During stimuli creation, participants wore plain black t-shirts, were asked to maintain a neutral expression, and were asked not to wear heavy make-up. Participants were then asked to stand behind a generic reception desk, and to pose for four separate photographs: one that included a poster and a lanyard; one that included a poster but did not include a lanyard; one that did not include a poster but did include a lanyard, and one that was absent of cues (Figure 1). All images were taken on a Canon 5D Mark 2 camera, and photographs were edited using Adobe Photoshop to ensure consistency across images in terms of size, placement, and resolution. The 144 images were divided into four experimental blocks, and presentation was pseudorandomised such that a photograph of each individual appeared only once in each block. Each block also contained 34 filler items, resulting in a total of 280 photographs. Thus, the experiment was composed of a 2(Lanyard: Present, Absent) x 2 (Poster: Present, Absent) repeated measures design, with 36 trials in each experimental condition.

Procedure

This study was conducted in-person, before the Covid-19 pandemic. Participants viewed all 280 photographs, presented at centre screen position on a plain white background. Images were presented for 3000 ms with a 200 ms inter-stimulus interval, and participants were instructed to indicate which language they would speak with the individual in the photograph, by means of a button press. Written instructions were presented in both Welsh and English, and response keys were counterbalanced across participants. The experiment was divided into four blocks, and presentation order was pseudorandomized, such that two images of the same individual never appeared in the same block. Presentation of stimuli within a block was randomised.

Having completed the experimental task, participants were asked to complete two additional tasks: a language history questionnaire, and a recognition task. The language history questionnaire was used to obtain demographic information such as age of acquisition, native language, and language proficiency. The recognition task was used to ensure that participants did not recognise any of the individuals presented as experimental stimuli. During this task, participants viewed images of the 36 individuals who contributed to the experimental stimuli and were asked to indicate the extent to which they recognised the individual on a scale of 1 to 5. A score of 1 indicated that they did not recognise the individual in the photograph, a score of 3 indicated that the participants recognised the individual in the photograph but did not know them, and a score of 5 indicated that the participants knew and interacted with the individual in the photograph. Any stimuli that received a score higher than 3 was removed prior to data analysis. This procedure was done separately for each participant. If participants indicated that they recognised more than six of the photographs, they were not included in the final analysis. This led to the removal of six participants.

At the end of the experiment, participants were fully debriefed. During this process, participants were asked whether they noticed anything about the study and were then further prompted about the language cues used in the study. Eighteen participants indicated that they noticed the presence of the Iaith Gwaith logo. Of these, 12 stated that the presence of a language cue influenced their choice – however, no participants explicitly stated that they realised that the purpose of the experiment was to evaluate the use of language cues. Finally, two participants indicated that they made their language choice based on the individual's face, with one stating that the age of the individual influenced their language choice. No participants were removed based on their responses in the debrief stage.

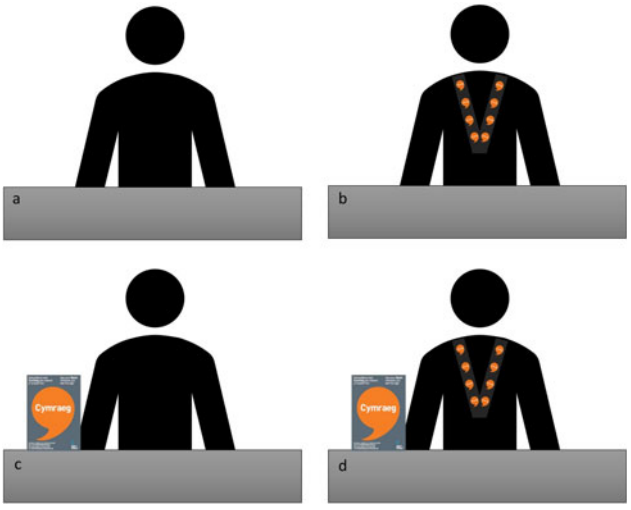


Figure 1. An illustration of the four experimental conditions used in this task. Panel a depicts the 'no cue' condition, panel b depicts the 'lanyard no poster' condition, panel c depicts the 'poster no lanyard' condition, and panel d depicts the 'lanyard and poster' condition.

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Data analysis

The data and script used for analysis are available at https://osf.io/c6ky4/.

Data were analysed using the lme4 package, version 1.1-12, (Bates, Maechler, Bolker & Walker, 2015) in R version 3.2.3 (R Core Team, 2015). Language choice was analysed by means of a binomial logistic regression, and response time data were examined with linear mixed effects analyses. Prior to analysis, response times that exceeded 2.5 standard deviations above or below the mean were excluded, resulting in a loss of 3% of trials. An interaction term for the two repeated measures factors (Lanyard*Poster) was included for both analyses, and the baseline (intercept) of each analysis comprised the 'no lanyard' and 'no poster' conditions. The 'stimuli' variable was modelled as a function of intercept performance, whilst the 'participant' variable included the intercept, plus the maximal slope of Lanyard*Poster (Barr, Levy, Scheepers & Tily, 2013).

Treatment contrasts were used to interpret the model output, and the specifications of each model allowed for two fixed effects as well as one interaction term. Fixed Effect 1 compared 'no poster' trials in 'lanyard' and 'no lanyard' conditions. Fixed Effect 2 compared 'no poster' trials with 'poster' trials in 'no lanyard' conditions. Finally, the Interaction assessed the extent to which differences in 'no poster' vs. 'poster' trials were specifically attributable to 'no lanyard' vs. 'lanyard' conditions.

Results

Language choice

The results of the binomial logistic regression can be seen in Table 1. A significant effect of Lanyard was found: participants were more likely to select Welsh as the language of choice when a lanyard was present than when it was absent. In addition, a significant effect of Poster was found: participants were more likely to select Welsh as the language of choice when a poster was present than when it was absent. A significant Lanyard*Poster interaction also emerged: simple effects contrasts revealed that, for trials in which a lanyard was absent, participants were more likely to select Welsh as the language of choice when a poster was present than when it was absent (*Estimate* = 3.05, *SE* = 0.57, $z = 5.34$, $p < .001$). However, for trials in which a lanyard was present, no difference was observed between 'poster' and 'no poster' trials (*Estimate* = 0.18, *SE* = 0.13, $z = 1.39$, $p = .166$). In contrast, participants were more likely to select Welsh as the language of choice when a lanyard was present than when it was absent, both during trials in which a poster was present (*Estimate* = 0.65, *SE* = 0.17, $z = 3.88$, $p < .001$) and absent (*Estimate* = 3.61, *SE* = 0.57, $z = 6.38$, $p < .001$; see Figure 2). Note, however, that this difference was more pronounced during trials in which a poster was absent. The same pattern was observed when analysing Block 1 independently, and this global pattern was consistent across all four experimental blocks.

Table 1. Fixed effect estimates derived from the binomial logistic regression on Language Choice data.

	Estimate	Std. Error	z value	p value
Intercept	−0.032	0.287	−0.111	.912
Lanyard	2.782	0.394	7.065	< .001
Poster	1.972	0.353	5.588	< .001
Lanyard*Poster	−1.374	0.319	−4.303	< .001

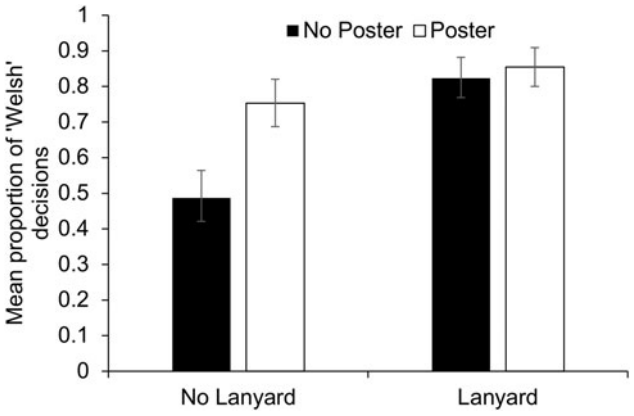


Figure 2. Participant responses on the Language Choice task. Error bars represent the standard error of the mean.

Additional exploratory analyses were conducted to determine whether first language choice (choosing Welsh or English in Block 1) affected language choice when subsequently exposed to the stimuli (language choice in Block 2, 3, and 4), regardless of the experimental condition (Table 2). Here, the baseline was First Choice Welsh, Block 2. These data reveal that, for trials in which the initial response was 'Speak Welsh', the proportion of 'Speak Welsh' choices steadily increased over the remaining blocks, with a higher proportion of 'Speak Welsh' decisions in Block 3 compared with Block 2 (*Estimate* = 0.39, *SE* = 0.16, $z = 2.39$, $p = .017$), and in Block 4 compared with Block 2 (*Estimate* = 0.62, *SE* = 0.21, $z = 3.01$, $p = .003$). For trials in which the first response was 'Speak English', the opposite pattern emerged, with the proportion of 'Speak Welsh' choices steadily decreasing over the remaining blocks (see Figure 3). Note, however, that this interaction was not significant.

This exploratory analysis investigated the effect of initial language choice on subsequent trials without considering the experimental factors of lanyard and poster. To determine whether the effect of language cues differed as a result of initial language choice, we conducted an additional analysis in which we included first language choice as a factor in the original model (Table 3). For this analysis, the baseline was First Choice Welsh, No Lanyard, No Poster. The overall pattern of results mirrors those

Table 2. Fixed effect estimates derived from the binomial logistic regression to determine the effect of First Language Choice on subsequent Language Choice data.

	Estimate	Std. Error	z value	p value
Intercept	1.171	0.241	4.855	< .001
First Choice English	0.582	0.342	1.703	.088
Block 3	0.387	0.162	2.385	.017
Block 4	0.616	0.205	3.006	.003
First Choice English: Block 3	−0.665	0.367	−1.812	.070
First Choice English: Block 4	−0.745	0.426	−1.749	.080

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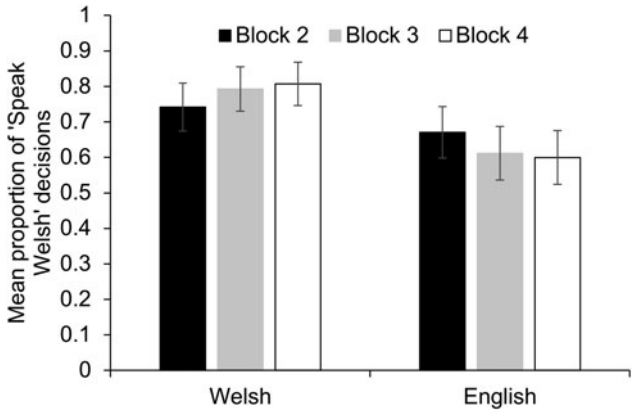


Figure 3. Participant responses on the Language Choice task across Blocks 2, 3, and 4, split by First Language Choice (Welsh vs English) in Block 1. Error bars represent the standard error of the mean.

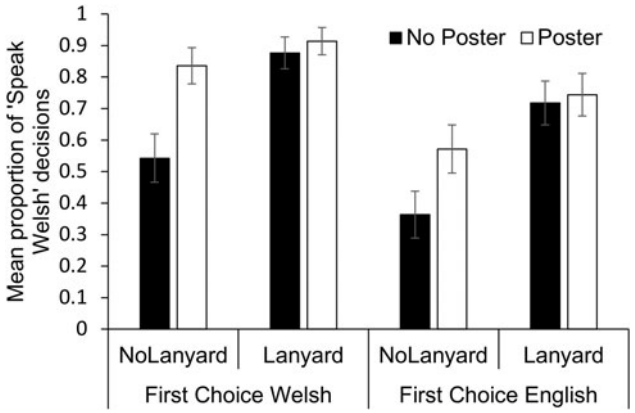


Figure 4. Participant responses on the Language Choice task across all four conditions, split by First Language Choice (Welsh vs English). Error bars represent the standard error of the mean.

seen in the original confirmatory analysis – however, the proportion of 'speak Welsh' choices was generally lower in cases where English was initially chosen as the language of choice (Figure 4).

Response time

The results of the linear mixed effects analysis can be seen in Table 4. A significant effect of Lanyard was found: participants responded faster when a lanyard was present than when it was absent. In addition, a significant effect of Poster was found: participants responded faster when a poster was present than when it was absent. A significant Lanyard*Poster interaction also emerged: simple effects contrasts revealed that, for trials in which a lanyard was absent, participants responded faster when a poster was present than when it was absent (*Estimate* = −82.79, *SE* = 19.40, *t* = −4.27). However, for trials in which a lanyard was present, no difference was observed between 'no poster' and 'poster' trials (*Estimate* = −1.06, *SE* = 11.48, *t* = −0.09). In contrast, participants responded faster when a lanyard was present than when it was absent, both during trials in which a poster was present (*Estimate* = −81.38, *SE* = 19.87, *t* = −4.10) and absent (*Estimate* = −163.80, *SE* = 22.90, *t* = −7.15; see Figure 5). Note, however, that this difference was more pronounced during trials in which a poster was absent.

Additional exploratory analyses were conducted to determine whether the effect of language cues differed in trials where Welsh was selected as the language of choice, and trials where English was selected as the language of choice (see supplementary materials). In this analysis, the baseline was Language choice: Welsh, No Lanyard, No Sign. When Welsh was selected as the language of choice, the overall pattern of results mirror those seen in the original confirmatory analysis. When English was selected as the language of choice, a slightly different pattern emerged: response times in 'No Lanyard' trials were similar for trials in which a poster was present and absent. Note, however, that the three-way interaction was not significant. Furthermore, responses were generally slower when English was selected as the language of choice than when Welsh was selected as the language of choice.

Discussion

Here, we investigated the effect of non-linguistic cues on language selection in highly-proficient Welsh–English bilinguals. We presented participants with a series of images that contained various types of non-linguistic cues (which were not referred to in the task instructions) and asked them to indicate which language they would speak to the individuals in the images, by means of a button press.

We found that the presence of an external cue (the Iaith Gwaith logo) had a significant impact on participant performance: participants selected 'Welsh' as their language of choice

Table 3. Fixed effect estimates derived from the binomial logistic regression to determine the effect of First Language Choice, Lanyard and Poster on Language Choice data.

	Estimate	Std. Error	z value	p value
Intercept	0.100	0.371	0.270	.787
First Choice English	−0.601	0.355	−1.692	.091
Lanyard	3.456	0.605	5.713	< .001
Poster	2.233	0.443	5.036	< .001
First Choice*Lanyard	−0.839	0.504	−1.665	.096
First Choice*Poster	−0.164	0.432	−0.379	.705
Lanyard*Poster	−2.148	0.548	−3.923	< .001
First Choice*Lanyard*Poster	1.281	0.757	1.691	.091

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Table 4. Fixed effect estimates derived from the linear mixed effects analysis on reaction time data.

	Estimate	Std. Error	t value
Intercept	960.25	31.56	30.424
Lanyard	−165.08	23.13	−7.137
Poster	−84.83	19.67	−4.313
Lanyard*Poster	84.03	21.78	3.858

$t > 3.29$; $p < .001$.

more frequently in trials that contained a cue than in trials that did not contain a cue. Participants also responded faster in trials that contained a cue than in trials that did not contain a cue. These findings suggest that external, non-linguistic cues can be used to prime language selection in bilinguals, in line with recent findings (e.g., Bhatia et al., 2017; Kapiley & Mishra, 2019), and provide support for theories positing a mechanism for language selection in a nonselective bilingual lexicon.

Interestingly, the way in which the language cue was presented (poster vs lanyard) also affected participant performance on the task. In terms of language choice, participants selected Welsh as the language of choice least often when neither a lanyard nor a poster were present, and selected Welsh as the language of choice most often when both a lanyard and a poster were present. When a lanyard was present in the photograph, the presence or absence of a poster made no difference to the language selections of participants. However, when a lanyard was not present in the photograph, the presence of a poster had a positive effect on language choice. In contrast, participants were more likely to select Welsh as the language of choice when a lanyard was present than when it was absent, regardless of whether a poster was present or absent. Note, however, that this difference was more pronounced during trials in which a poster was absent. A similar pattern was observed in the response time data: when a lanyard was present in the photograph, the presence or absence of a poster made no difference to response times. However, when a lanyard was not present in the photograph, participants responded faster when the photograph included a poster than when the photograph did not include a poster. In contrast, participants responded faster when a lanyard was present than when it was absent, regardless of whether a poster was present or absent. Note, however, that this difference was more pronounced during trials in which a poster was absent. Thus, whilst both cue types had an impact on language choice and response times, these data suggest that the presence or absence of a lanyard had more of an impact on participant performance than the presence or absence of a poster. These findings could be attributed to the perceived reliability of the language cues used. Previous findings by Woumans et al. (2015) suggest that the impact of an external language cue reduces when the reliability of said cue diminishes. In the current study, it is possible that participants perceived the lanyard to be a more reliable cue than the poster, as it clearly indicated that the individual could speak Welsh. The poster, however, could be perceived as less reliable, as the presence of a poster doesn't identify which specific individuals speak Welsh. This is further supported by the fact that response times to trials in which a lanyard was present but a poster was absent were faster ($M = 819$ms) than trials in which a poster was present but a lanyard was absent ($M = 912$ms), and that participants selected Welsh as the language of choice more often in trials in which a lanyard was present but a poster was absent ($M = 82\%$) than in trials in which a poster was present but a lanyard was absent ($M = 75\%$). This interpretation is speculative, and further investigation is needed to fully understand participant perception towards the different types of language cues presented here.

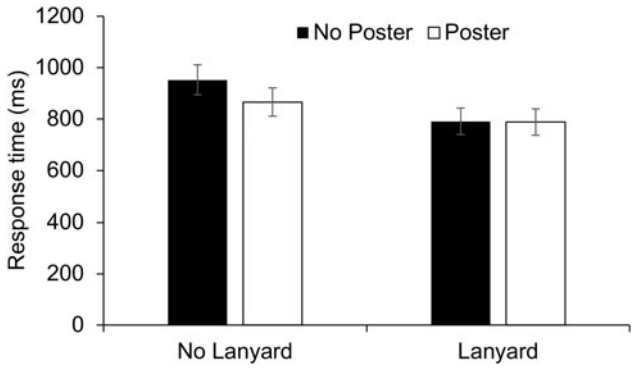


Figure 5. Participant response times (ms) across all experimental conditions. Error bars represent the standard error of the mean.

The response time data observed here suggest that language cues can have a facilitatory effect, with shorter response times when cues were present than when cues were absent. Whilst these data align with previous findings (e.g., Bhatia et al., 2017; Kapiley & Mishra, 2019), consideration should be given to the methodological differences between these papers. Previous studies typically investigated the influence of external cues on naming latencies, with faster responses when the naming language matched the external cue than when the naming language did not match the external cue (e.g., de Bruin & Martin, 2022). Our confirmatory (i.e., a-priori) analysis focused on the influence of language cues on response times, irrespective of the language of choice. Given previous findings, however, it is possible that the influence of language cues on response times differed, depending on the language of choice selected by participants. An additional exploratory analysis revealed that, when the language of choice was Welsh, the pattern of data mirrored that found in the initial confirmatory analysis: responses were faster in language cue trials than in no-cue trials. The pattern of data was slightly different in English, though this interaction was not significant. Interpreting the pattern of data when English was selected as the language of choice is difficult and speculative, given the low number of trials in the cue conditions. Furthermore, these data likely contain responses from participants who had a general preference for English over Welsh and participants who had a preference for Welsh but selected English in the more ambiguous conditions (e.g., no lanyard, no poster; no lanyard, poster). Future iterations of this study could investigate this possibility further.

In contrast to previous studies exploring the influence of external cues on language choice (e.g., Bhatia et al., 2017; de Bruin & Martin, 2022; Kapiley & Mishra, 2019), participants were not asked to produce a verbal response as part of the current study. Rather, they were asked to state which language they would speak, by means of a button press. As such, it could be argued that these findings may not reflect the influence of language cues on natural language production, and may be the result of demand characteristics. That is, participants may have selected

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Welsh as the language of choice more frequently in trials containing a language cue as this was the 'expected' response. Indeed, during the debriefing process, 18 participants indicated that they noticed the language cues, and 12 believed that they influenced their decisions in the task. If the findings merely reflected 'expected' responses, we argue that no differences should have emerged between the three conditions in which a language cue was present, and the mean proportion of 'Speak Welsh' decisions should have been at ceiling level for all three cue conditions. This was not the case. In addition, if participants were responding in the 'expected' way, we would expect a much lower proportion of 'Speak Welsh' decisions in the condition containing no language cues. As such, we argue that these data reflect the influence of language cues on natural language production. Whilst previous studies asked participants to produce a verbal response, Kapiley and Mishra (2019) also asked participants to make an explicit language choice. In their study, Telugu–English bilingual participants were initially familiarised with cartoons that were presented alongside Telugu and English speech-samples, before being asked to rate the cartoon's proficiency in both Telugu and English. During the experimental task, participants were presented with a cartoon from the familiarisation phase and were asked to indicate which language (Telugu or English) they would speak to the cartoon. After indicating their language choice, participants were then presented with an image of an object that they had to name verbally. They found that participants selected English as the language of choice significantly more often when they perceived the cartoon as being highly proficient in English than when they perceived the cartoon as having low proficiency in English, indicating that the cartoon influenced language choice. In a follow-up experiment, they removed the language choice element: participants were presented with a cartoon from the familiarisation phase, before being presented with an image to name verbally. The pattern of responses mirrored the first experiment: participants chose to name an object in English significantly more when they perceived the cartoon as being highly proficient in English than when they perceived the cartoon as having low English proficiency. Taken together, these findings suggest that external cues can influence responses in an explicit language choice task and in a naming task in a similar manner.

In the current study, a repeated measures design was used, where participants saw four iterations of the same stimuli (i.e., participants saw Person A in the four experimental conditions). Presentation of these stimuli was fully counterbalanced across blocks and participants – however, it is possible that previous encounters with a specific stimuli could influence subsequent responses to that stimuli. To clarify, if a participant initially selected Welsh as the language of choice for Person A, they may have continued to select Welsh as the language of choice for Person A in subsequent trials, regardless of the language cues presented. Indeed, previous research into the influence of language cues on naming language suggest that participants tend to stick to the language used when initially exposed to a stimulus (de Bruin & Martin, 2022). We thus conducted additional exploratory analyses to investigate the influence of Language Choice in the first block (i.e., initial exposure to the stimuli) on language choice in subsequent blocks (Table 2). This exploratory analysis revealed that the language chosen in the first block influenced language choice in subsequent blocks: the proportion of 'Speak Welsh' decisions steadily increased across Blocks when Welsh was initially selected as the language of choice, whilst the proportion of 'Speak Welsh' decisions steadily decreased across Blocks when English was initially selected as the language of choice. Given this pattern of data, and the fact that the proportion of 'speak Welsh' choices was generally lower after participants initially selected English as the language of choice, it's plausible that past exposure with an interlocutor does influence language choice. We also investigated whether First Language Choice modulated the overall effect of language cues (Table 3). The overall pattern of results mirrored those seen in the original confirmatory analysis, with a higher proportion of 'Speak Welsh' decisions in the cue conditions than in the no cue condition. Whilst the proportion of 'Speak Welsh' choices was generally lower in cases where English was initially chosen as the language of choice than when Welsh was initially chosen, this interaction was not significant. Thus, whilst prior language choice appears to have an effect on subsequent language choice, it does not negate the impact of language cues.

These findings thus provide further evidence to suggest that non-linguistic cues can be used to impact language selection and activation. However, it is important to consider the linguistic context in which the study took place when interpreting and applying these findings. Bangor University is a bilingual university, located in a county where a high proportion (76%) of individuals speak both Welsh and English fluently (Office of National Statistics, 2021). As such, it could be argued that our sample of bilinguals was already operating in a 'bilingual mode' (Grosjean, 1998, 2008). In addition, the high number of Welsh–English bilinguals in the area may have influenced participant responses, as they may have assumed that the individual in the photograph could speak both languages. The data from the 'no cue' trials support this suggestion, where participants performed at chance level, despite the fact that no language cues were present. Whilst this pattern of data is positive, as it suggests that the decision to use a language does not depend entirely on the presence of an external language cue, it may indicate a population bias, and the effectiveness of the language cues may be inflated as a result. Future studies could investigate this possibility by replicating the study in an area where the prevalence of Welsh–English bilinguals is substantially lower.

Another factor that could be investigated further in future studies is the interaction between language proficiency and the effectiveness of external language cues. Research in the field of co-activation has provided conflicting results to date, with some researchers stipulating that co-activation can be bidirectional (i.e., the first language (L1) can be activated during second language (L2) processing, and L2 can be activated during L1 processing; van Assche, Duyck, Hartsuiker & Diependaele, 2009), and others stressing the asymmetry of co-activation (activation of L1 during L2 processing is typically stronger than activation of L2 during L1 processing; Weber & Cutler, 2004). Similar theoretical questions could be asked here, and it could be argued that whilst external language cues may be effective in prompting the use of L1 over L2, they may not be as effective in promoting the use of L2 over L1. Our sample consisted of highly proficient, Welsh–English bilinguals, who self-reported that they were more proficient in Welsh than in English both in terms of speech production and comprehension. As such we cannot attest to the impact of these language cues on individuals who are less proficient in Welsh, or who use Welsh less frequently than English. Future studies could thus replicate this study with a sample of L2 Welsh speakers, to determine

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whether external language cues can promote the use of a second, less proficient language, over the use of a dominant language in a bilingual setting.

The results of the current study provide evidence to support the suggestion that language choice can be influenced by external language cues (i.e., bottom-up processes). However, given the pattern of data observed, additional factors may also be at play. Whilst participants were less likely to select Welsh as the language of choice during no cue conditions, Welsh was still chosen as the language of choice in roughly 50% of trials, suggesting that participant choice was not determined entirely by the presence or absence of cues. One factor that may have influenced participant responses is overall language preference (i.e., the language that participants prefer using in daily life). In a recent study, de Bruin and Martin (2022) demonstrated that external primes and language preference influenced naming language and response times. In their study, Spanish–Basque bilinguals were initially asked to state their naming preference (Spanish or Basque) for a list of pictures. A subset of these images was used during the experiment, where participants completed a voluntary naming task. Participants completed three versions of the task: a no-prime version, in which the images were presented in isolation; a linguistic prime task, in which the images were preceded by a written sentence that the participants had to read aloud; and, a non-linguistic prime task, in which the images were preceded by the Spanish or Basque flag. For no-prime tasks, participants were less likely to name an image in Basque when they had a Spanish preference for the image than when they had a Basque preference for the image. Participants also responded faster when the naming language matched their language preference than when it did not. A similar pattern was observed in the primed tasks. In addition, participants were more likely to name an image in Basque when preceded by a Basque cue than when preceded by a Spanish cue and were faster to respond when the naming language matched the preceding prime (e.g., naming in Basque when the item was preceded by a Basque cue) than when it did not match the preceding prime (e.g., naming in Basque when the preceding prime was Spanish). Interestingly, the effect of language preference on language choice did not differ significantly between prime and no-prime tasks. For both naming language and RTs, the effect of language preference and external cues was additive (i.e., participants responded faster when the naming language matched both the prime and their language preference). These findings suggest that language choice can be modulated by top-down (language preference) and bottom-up (external cues) processes. A future iteration of the current study could thus measure overall language preference to investigate the additive effects of preference and language cues when making an explicit language choice. Furthermore, future iterations of the study could include a voluntary naming task, using a similar design to de Bruin and Martin (2022), to determine the effect of item-specific language preference on language choice, and whether this effect is modulated by language cues. A key difference between the current study and de Bruin and Martin (2022) is that the cues used in our study were, in some way, task-relevant (as they are used to prompt language use in daily life). These language cues also provided information about the linguistic context, meaning that language preference effects may manifest differently. For example, participants may equate the 'no-cue' condition with a monolingual environment and choose to name items in English, regardless of their preference. Conversely, participants may equate the cue conditions with a bilingual environment in which either language could be spoken, and may thus be more inclined to follow their language preference. Such an iteration would allow us to determine the combined effect of language preference and task-relevant language cues on naming language, providing additional insight into the mechanisms underpinning language choice in bilinguals.

These findings support theoretical models that suggest the influence of non-linguistic cues on language choice. The findings also provide empirical evidence to support the use of external language cues to promote the use of one language over the other in a bilingual context. As such, these findings have far-reaching impact, and could be used to support the development of language prompting schemes in other countries that are trying to promote the use of minority languages. Further studies are now required to understand the impact of linguistic context, language proficiency, and language preference on the influence of external cues on language selection.

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