A cognitive perspective on equivalent effect: using eye tracking to measure equivalence in source text and target text cognitive effects on readers

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Eye-tracking methods have long been used to explore cognitive processing in reading, but the recent burgeoning of such methods in the field of translation studies has focused almost entirely on the translation process or audiovisual translation, neglecting the effects of the translation product itself. This paper presents a proof-of-concept study using eye tracking to compare fixation data between native readers of a French literary source text and native readers of its English translation at specific, corresponding points in the texts. The preliminary data are consistent with previous findings on the relationship between the features of the fixated word and fixation durations. These findings are also consistent with stylistic analyses and indicate that this method can be used to compare the levels of cognitive effort between two readership groups in order to investigate whether their experience is similar – whether an 'equivalent effect' has been achieved –, thus contributing to the on-going discourse surrounding equivalence in translation studies.

Keywords: eye tracking; equivalence; equivalent effect; reception; cognitive effort; cognitive translation studies

Introduction

Eye tracking has been incorporated into translation process research with increasing intensity over the past decade, but the use of eye tracking to investigate the reception of translation products and their cognitive effects is still relatively scarce (Hvelplund, 2017; H. Kruger and Kruger, 2017). With the exception of audio-visual translation, which has examined the processing of subtitles (for a summary, see J.-L. Kruger, 2016), and research on the reception of machine-translated output (Doherty and O'Brien, 2014; Doherty, O'Brien, & Carl, 2010), the opportunities provided by eye-tracking methods have seen relatively little application to text reception in translation studies (TS). One notable exception is Kruger's study on the processing of foreignised text in South

African picturebooks (H. Kruger, 2012, pp. 217-268; 2013), which employs a similar method to the one proposed in this paper to investigate how children and adults react to textual elements yielded by different translation strategies. Other studies include Jakobsen and Jensen's (2008) eye-tracking experiments investigating different types of reading practices; theoretical papers on measuring text comprehensibility and readability using methods such as eye tracking (Hansen-Schirra and Gutermuth, 2015; Wolfer, 2015); and reports on eye-tracking experiments investigating language processing in a monolingual natural language context (Müller-Feldmeth et al., 2015; Wolfer, Hansen-Morath, & Konieczny, 2015). However, none of these studies has directly addressed the problem of comparing the reading experience of source-text (ST) readers with that of target-text (TT) readers.

The majority of TS research on the reader's experience and translation 'effects' (see Chesterman, 1998) has been based on subjective intuition with little or no empirical justification (H. Kruger, 2013, p. 180). This paper argues that the same principles that are becoming widespread in translation process and audio-visual translation research can be re-applied to compare the reception of a translation with that of the ST at points where the text is stylistically marked. The quasi-experimental design described in this paper is presented as a 'proof of concept', to compare the reading experience of the ST with that of the TT and, therefore, to provide a tentative means to investigate the effects of translation.

In the eye-tracking paradigm, visual attention is frequently employed as a proxy for cognitive effort (Lacruz, 2017), which refers, in this paper, to the mental effort involved in reading, and is reflected in the time taken to complete discrete steps in the reading process (see 'temporal effort', Krings, 2001). This relationship between what the eyes are fixating and how long they are fixating it, and the reader's cognitive effort,

mirrors the vast body of reading research recognising the influence of lexical, syntactic and orthographic factors, among others, on visual attention and, therefore, the language processing (for comprehensive reviews, see Liversedge, Gilchrist, & Everling, 2011; Rayner, 1998). This paper uses three different eye-tracking measurements – first fixation duration, gaze duration and total fixation duration – to consider how these metrics reflect different stages of the reading process and allow 'equivalent effect' between a ST and TT to be tested. The data presented in this paper are confined to seven areas of interest (AOI), allowing for a greater focus on the theoretical and methodological foundations of this approach and their applicability to the reading of stylistic features.

To illustrate this methodology, the experiment uses extracts from a French novel – Raymond Queneau's *Zazie dans le métro* (1959) – and Barbara Wright's English translation – *Zazie in the Metro* (1960). In *Zazie*, Queneau playfully exploits the possibilities of the French language, not only to make the reading experience purposefully challenging for the reader (see *prière d'insérer*, Queneau, 1934), but also, in so doing, to encourage a forthcoming revolution in the French language, which he dubbed *néo-français* (Queneau, 1965, p. 64). His juxtaposition of passages of 'standard' French alongside a quasi-phonetic 'spoken' style results in the frequent use of so-called 'concertina-words' (Redfern, 1980, p. 45). These quasi-phonetic forms use elision, letter transposition and substitution, and agglutination, resulting in ordinarily recognisable words and phrases being 'mutilated' into a continuous, coagulated sound pattern: *ce que c'est*, for example, becomes *cexé* (p. 15), the Parisian quarter *Saint-Germain-des-Prés* transforms into *Singermindépré* (p. 29), and the phrase *elle ne bouge plus du tout* transmutes into *a boujpludutou* (p. 47). Given that critics have hypothesised their arresting effect on readers (Guicharnaud, 1965, p. 26; Redfern, 1980, p. 45), these

concertina-words offer an ideal environment to test this method in order to evaluate how well the cognitive impact of these stylistic elements has been carried over in translation.

The problem of equivalent effect

Translation theorists have explored the notion of 'equivalent effect' in various guises. The term was most famously proposed by Nida (1964, p. 159) as a key aspect of what he dubbed 'dynamic equivalence', whereby readers of the TT should 'respond to' the TT in 'substantially the same manner' as ST readers. Newmark's 'communicative translation' (1988, pp. 48-49) also spoke of a translation 'produc[ing] on its readers an effect as close as possible to that obtained on the readers of the original'. Other scholars have proposed 'types' of equivalence, such as Koller (1979), who spoke of denotative, connotative, text-normative, pragmatic and formal aspects of equivalence. The problem that this poses for Queneau's writing is that meaning, form and effect in *Zazie* are deeply embedded in the French culture and language and cannot be reduced to such simplistic taxonomies, hierarchies or binaries. A translation scholar can examine stylistic devices and compare linguistic choices in the ST and TT, but such comparisons do not tell us, beyond mere assumption, whether an 'equivalent effect' has been secured, or what 'equivalent effect' means. While some theorists have devised 'types' of equivalence, others are content with the illusory, 'self-evident' or presumptive nature of equivalence (notably Boase-Beier, 2006, pp. 41-42; Pym, 2010, p. 37).

The linguistic challenges posed by *Zazie* are manifold due to the complex interplay between language and culture. While not strictly a dialect, the difficulties of translating Queneau's *néo-français* are not dissimilar to those posed by dialect. Dialect translation is a vastly under-researched field in translation studies. However, a brief review of the field reveals the prevalence of a tendency to 'decaffeinat[e]' (Rodríguez Herrera, 2014) or 'standardis[e]' (Ramos Pinto, 2016) language varieties in translation.

Despite language varieties being a purposeful choice on the part of the ST author, the primary reason for omitting dialect in translation is the lack of an equivalent variety in the target language – in the case of *Zazie*, *néo-français*, by definition, does not exist in English.

Pym's (2000) discussion on the translation of language varieties makes the crucial point that language varieties should be considered a foreignising element of the *ST*, for they create distance between the author and receiver. This idea of distance resonates with Venuti's 'resistancy' and 'fluency' in translation (2008): namely that a foreignising effect can be produced by resisting prevalent norms. For example, *Zazie* is a 'resistant' text in French because Queneau defies French linguistic and cultural norms by using marginal (hitherto non-existent) resources in French. Hence, to seek equivalence, and to mirror this resistancy, the translation should be equally foreignising, *imitating* the features of the ST that resist dominant source culture values (see Venuti, 2008, p. 177). Thus, when translating a language variety, Pym argued (2000) that 'the thing to be rendered is not the source-text variety [but] the variation, the syntagmatic alteration of distance, the relative deviation from the norm'.

This paper does not look to explore why or how *Zazie* is resistant to or deviates from prevalent norms, but rather to treat the texts as artefacts that can be compared to consider whether the foreignising effects or 'resistancy' are the same. Scott referred to the process of reading literary texts as a 'choreography of effects' (2000, p. 185) that create a 'sequence of sensations activated in the reader' (2012, p. 11). TS has long grappled with the problem of documenting these effects, but this does not mean that it is impossible. The very fact that a text or element within a text can be described as 'resistant' speaks to the cognitive effects of stylistic features, as widely acknowledged (Boase-Beier, 2006; Munday, 2012). Hence, in the case of *Zazie*, if the ST's and TT's

normative resistancy is equivalent, the notion of 'otherness' (Venuti, 2008, p. 264) is equally marked, and the foreignising elements in the texts (Pym, 2000) are comparable, then it can be argued – subjectively – that an 'equivalent effect' has been achieved. What this paper proposes is a means to compare physiological manifestations of these effects on readers at stylistically-poignant points in the ST and TT where the foreignisation and linguistic resistancy are most evident. By borrowing the methods already permeating translation process research and re-applying principles from natural reading research, we can attempt to investigate the ways in which people read texts – in part satisfying Pym's call to know 'more about the way people actually receive translations' (2010, p. 37) – and consider whether empirical methods can be used to supplement the qualitative analyses that are still prevalent in reception-oriented TS research.

Lessons from reading research

Eye movements are widely recognised to react to the properties of fixated words – the so-called 'linguistic/cognitive position' (Rayner and Liversedge, 2011, p. 751) – with scholars almost unanimously recognising a direct correlation between longer or more frequent fixations (when the eyes are fixated on a particular point) and higher cognitive effort. In this model, the complexity of linguistic features has a (near-)instantaneous and proportional impact on cognitive effort, meaning that eye movements reflect 'moment-to-moment comprehension processes' (Rayner, Chace, Slattery, & Ashby, 2006), a hypothesis that Just and Carpenter posited almost 40 years ago (1980).

Two of the most widely documented effects in the eye-tracking literature are 'frequency' and 'predictability' effects, which assume that fixation durations will increase as word frequency and/or predictability decrease (Kliegl, Grabner, Rolfs, & Engbert, 2004). Hence, given that Queneau's concertina-words are low-frequency

(*hapax legomena*, in fact) and impossible to predict for readers unfamiliar with the text, they should, on average, result in longer fixations. However, this consideration for frequency and predictability effects alone is an oversimplification of some of the lower level effects that may be at play. Indeed, these concertina-words are low-frequency and difficult-to-predict because of orthographic manipulation. There has been considerable research on the reading of letter transposition and substitution, misspellings, and morphological compound-words, all of which contribute to these frequency and predictability effects.

Letter substitutions (e.g. *cloch<u>s</u>* instead of *clocks*) have all been found to have an effect on reading speed, with word-initial substitutions found to be most disruptive (Rayner and Kaiser, 1975). Similarly, letter transposition (e.g. *cou<u>dl</u>* instead of *could*) has been shown to have a 'cost' for reading speed. Compared with a baseline reading speed of 255 words per minute (wpm), Rayner, White, Johnson and Liversedge (2006) reported that internal-letter transpositions are found to be marginally disruptive (227 wpm, -11%), end-letter slightly more so (189 wpm, -26%), and initial-letter the most disruptive (163 wpm, -36%) (see also White, Johnson, Liversedge, & Rayner, 2008). Christianson et al. (2005) looked at the impact of letter transpositions across (*su<u>sn</u>hine*) and within (*sun<u>hs</u>ine*) morpheme boundaries, finding that, while within-boundary transpositions had a cost, cross-boundary transpositions were more disruptive.

The frequency of letter clusters has also been found to influence processing time with words containing infrequent letter clusters requiring longer fixation times. For example, White and Liversedge (2004) employed misspellings in word-initial letter clusters, varying the frequency of the cluster to investigate the effect of cluster frequency on fixation times (*agricultural* / *acricultural* / *aoricultural*, etc.). Their data showed an increase in gaze duration as a function of the frequency of the word-initial

cluster. Increased gaze durations are also widely reported for misspellings, more generally (see Inhoff and Topolski, 1994; Underwood, Bloomfield, & Clews, 1988).

There has also been considerable research on the impact of 'novel' words on processing times, showing that unknown words require additional time to integrate (Chaffin, Morris, & Seely, 2001) and novel prefixed words result in higher gaze durations (Pollatsek, Slattery, & Juhasz, 2008). Where morphemes are combined to create compound words (novel or otherwise), the lexical frequency of the morphemes and the length of compounds have been found to have an impact on gaze durations, with lower-frequency morphemes and longer compounds both having an upward effect on processing times (Andrews, Miller, & Rayner, 2004; Juhasz, 2008). More comprehensive summaries of lexical and linguistic influences on eye movements in reading can be found in Rayner (1998), Hyönä (2011), Juhasz and Pollatsek (2011), and Rayner and Liversedge (2011).

As will become apparent in the sections that follow, all of these lexical characteristics feature in Queneau's concertina-words: they are, in their base form, extremely low-frequency words whose occurrence is near-impossible to predict from prior context. When broken down into smaller units, they have this effect through letter substitutions, letter transpositions, infrequent letter clusters, misspellings, infrequent or unfamiliar morphological compounds, and, above all, novelty in their lexical form. While it is not the intention of this method to control these factors and measure their impact on eye movement data, these findings in eye-tracking literature allow us to fairly reliably predict that Queneau's concertina-words will have a significant impact on fixations. Under the linguistic/cognitive position, this heightened visual attention is taken to be representative of cognitive effort. We cannot, of course, be certain of *why* readers slow down at certain points in a text, but, from the literature briefly reviewed

above, we can offer logical linguistic justifications. Hence, what this proof-of-concept study proposes is a method to quantitatively compare the cognitive impact of the ST with the TT, focusing on concertina-words as examples of a highly marked stylistic language variety. Given the close relationship between textual features such as orthography and fixation durations, and between fixation durations and cognitive effort (Reichle, 2011), the fixation durations recorded over the concertina-words in the experiment texts will serve the basis for the comparative analysis between ST and TT readers, allowing an insight into their cognitive effort at these points in the texts.

Method

The method presented in this paper is more accurately described as a quasi-experimental design, given that the text extracts are unedited literary texts instead of carefully constructed passages, as frequently used in other eye-tracking studies. While there are drawbacks to a quasi-experiment (reduced control over variables and no control over the text surrounding the AOIs), a quasi-experiment can offer greater ecological validity, which is important in studies focusing on natural reading processes.

Participants

Thirty-one voluntary and consenting participants, recruited from Durham University's undergraduate and postgraduate students and staff, took part in the experiment, all with normal or corrected-to-normal vision and naïve as to the objective of the experiment[1]. Seventeen participants (3 male, 14 female, mean age 23) were native French speakers

[1] This experiment was approved by the University College London Research Ethics Committee (Project ID: 6624/001).

and were assigned to read extracts from the ST (Group S). Fourteen (5 male, 9 female, mean age 21) were native English speakers and read the corresponding extracts from the TT (Group T).

While various participant characteristics, such as reading skill, can influence the eye-tracking data obtained, such as reading skill (Everatt, Bradshaw, & Hibbard, 1998; Underwood, Hubbard, & Wilkinson, 1990), it was not the aim of this design, at this proof-of-concept stage, to control such factors – they may, however, be factored into an experimental design through pre-selection and/or post-experiment statistical controls in future studies. Thus, this quasi-experimental design acknowledges that the data may be influenced by participant factors, but the primary focus of this study is the broader methodological considerations derived from the data.

Stimuli

Four 700-1,500-word extracts were selected from the ST to be read by Group S, together with the corresponding sections of the TT to be read by Group T. Extended texts were chosen to 'engag[e] more normal comprehension processes' (Clifton Jr. and Staub, 2011, p. 896), given that isolated phrases would be an oversimplification of natural reading processes (Rayner and Liversedge, 2011, p. 757). Seven concertina-words were delineated as AOIs for this analysis (see Table 1), four of which have been translated in a stylistically 'equivalent' manner in the TT, and three of which have not. Hence, these AOIs provide examples where equivalent effect is assumed to have been both achieved and not achieved. The stylistic features of these AOIs will be briefly discussed below and are provided with some context in Appendix 1.

AOI	Source text	Standard French (for comparison)	Target text	Standard English (for comparison)
A	Doukipudonktan	D'où (est-ce) qu'ils puent donc tant	Howcanaystinksotho	How can they stink so (much) though
B	Skeutadittaleur	Qu'est-ce que tu as dit tout à l'heure	Wottusaidjusnow	What did you just say
C	Ltipstu	Le type se tut	The chapshutistrap	The chap shut his trap
D	Immbondit dssus	Il me bondit dessus[i]	he pounced on me	*(no change)*
E	Isrelève	Il se relève	He gets up again	*(no change)*
F	jitrouas	J3[ii]	post-war generation	*(no change)*
G	bloudjinnzes	blue-jeans	blewgenes	(blue) jeans

[i] The form given for comparison reflects standard spelling, but not standard grammar (which would likely be: 'il bondit sur moi').
[ii] J3 was a nickname given to war-time adolescents in France, based on the code listed on their ration cards.

Table 1. Comparison of concertina-words with standard spellings

In their most basic form, all of the ST AOIs exhibit traits of misspelling, combined with the creation of novel compound words through a form of agglutination, which have all been found to increase fixation durations, and hence cognitive effort. However, the degree to which this stylistic use of misspelling and compounding is replicated in the TT differs, resulting in differing levels of cognitive effects in the translation.

The most frequent component of Queneau's concertina-words, besides the obvious formation of novel compound words, is the elision of mute vowels and simplification or assimilation of consonant clusters, both of which involve letter transposition and/or substitution or, in other cases, simple misspelling, where letters have been removed. An example of this is AOI-D, in which the *l* assimilates to an *m* and the mute *e* in *me* and *dessus* is elided, combined with the agglutination of the first three words into *Immbondit*. Similar orthographic manipulations are also present in the ST versions of AOI-A, -B, -C, and -E. AOI-F is worthy of special note because it is in fact a quasi-phonetic, novel representation of *J3* (/ʒi tʀwɑ/), which poses problems for readers in terms of simple linguistic processing, but also the cultural concepts that it

embodies. Similarly, AOI-G expands the typical Anglicism *blue-jeans*, replacing the English loan *ue* with the common French digraph *ou*, and confounding the orthographic form with infrequent consonant clusters: *bl*, *dj* and *nn*. This combination of resistant, foreignising factors – letter substitution and/or transposition, infrequent consonant clusters, elision, novelty, and misspelling – are therefore hypothesised to evoke higher levels of cognitive effort for French readers, especially considering that they appear in already unfamiliar compound forms.

These novel forms are replicated with varying degrees of foreignisation in the TT, with some (AOI-A, -B, and -C) employing a near-identical strategy of orthographic manipulation and compounding to replicate the ST effect. However, ignoring the novel compound forms, the severity of the transformations present in AOI-A (*they* > *ay* and *though* > *tho*) and AOI-C (*his* > *is*) is significantly less than those in the French, suggesting that the cognitive effort required to process these forms may not be as high, meaning that an equivalent effect may not have been achieved. AOI-D, -E and -F are instances where the translation has not used any resistant stylistic forms, instead employing standard, high-frequency language. In the case of AOI-F, this is unavoidable, given the cultural specificity of the term *J3*, compounded by the fact that any orthographic manipulation would have seemed gratuitous. As for AOI-D and -E, the TT's neutralisation of the ST's concertina form suggests that an equivalent effect will not be obtained. Finally, in an attempt to replicate the foreignisation present in the ST, AOI-G employs contextually inappropriate homophonic morphemes (*blew*+*genes*). This strategy should result in an equivalent cognitive effect for TT readers, given that the TT has been marked in a way that significantly deviates from the linguistic norm.

In summary, AOI-A, -B, -C, and -G are hypothesised to have achieved an equivalent effect in the TT, having used similar strategies of compounding and

orthographic manipulation to resist the linguistic norms of English and mirror the resistancy of these concertina-forms in French. In contrast, since there is no deviation from the linguistic norm in AOI-D, -E and -F, these AOIs are assumed to have not achieved an equivalent effect. These hypotheses were tested, using fixation data from the eye-tracking experiment, in order to measure whether the cognitive effort for those reading the ST (Group S) and those reading the TT (Group T) were quantitatively similar and, hence, whether an equivalent effect was secured in the TT at these points.

Apparatus and presentation

The text extracts were transcribed double-spaced in Arial 15-point and displayed in book format (two pages side-by-side) in Tobii Studio v.3.3. Tracking was performed using a Tobii TX300 eye tracker, with the integrated 23" TFT monitor (1920x1080 resolution). Participants sat 60-65 cm from the screen, without any immobilising apparatus, in an enclosed laboratory with controlled artificial lighting. All texts were presented in the order that they appeared in the novel to ensure narrative continuity in the events depicted. However, presentation order could easily be randomised in future experiments to control for order effects.

Protocol

After signing a consent form and completing a brief profiling questionnaire, participants were instructed to minimise body and head movements and to read in silence 'for comprehension' (as per Jakobsen and Jensen, 2008) with a view to answering simple comprehension questions after each extract. These questions were solely intended to reduce the likelihood of 'mindless reading' (see Reichle, Reineberg, & Schooler, 2010). Following a nine-point calibration of the eye tracker, each participant read the first extract, turning the page with the arrow key on the keyboard, before answering the

comprehension questions orally for that extract. This process was repeated for the remaining three extracts.

Data handling

The analysis employed three eye-movement measures: first fixation duration (FFD), gaze duration (GD), and total fixation duration (TFD), as defined in Table 2 (adapted from Juhasz and Pollatsek, 2011).

Measure	**Definition**
First fixation duration (FFD)	Duration of the very first fixation in the AOI
Gaze duration (GD)	Sum of first-pass fixations in the AOI
Total fixation duration (TFD)	Sum of all fixations in the AOI (including regressions)

Table 2. Eye-tracking measures

FFD and GD, being first-pass metrics, are useful as a reflection of a reader's initial access to word meaning, with FFD being particularly indicative of the initial 'shock' of accessing an unfamiliar word and GD reflecting text integration processes (Rayner, 1998, p. 377). TFD is a cumulative measure of fixation durations, providing an insight into the total cognitive effort exerted by the reader over a particular AOI (Juhasz and Pollatsek, 2011, p. 874). Viewed together, these three measures allow for a comprehensive, three-stage interpretation of cognitive effort over the AOIs, from the initial processing stages up to the point where overt visual attention shifts and processing of the AOI is presumed complete.

Two Group T participants' data were discarded due to corrupted data recordings. All other participants obtained good sample rates in Tobii Studio (> 75%), thus not requiring any additional exclusion of datasets, based on this criterion. Other measures of

data quality (such as overall mean fixation duration and total task time) were not considered appropriate for this study, given its attempt to investigate the reading practices of an uncontrolled readership. In cases where fixation placement was 'borderline' within AOIs, the analysis erred on the side of caution and excluded such cases from the fixation data for the relevant AOI[2]. Outliers were not removed for the analysis in this paper, as all eye-movement data were considered to be a reliable reflection of each participant's reading experience, however 'deviant' it might seem. However, in future studies, with the benefit of more participants, there is the option of investigating outlier removal or filtering based on certain criteria (see, for example, Doherty, 2012, p. 142ff; Hvelplund, 2011, p. 103ff).

The FFD, GD and TFD data were all adjusted to yield a character-adjusted figure by dividing the data by the number of characters (including spaces) within the AOI in question, in order to account for word-length effects, as longer words typically require longer or more fixations (Kliegl, et al., 2004). While some reservations have been expressed about such adjustment procedures (Rayner, 1998, p. 377; Trueswell, Tanenhaus, & Garnsey, 1994), in this study, the comparison is between regions that are intended to represent each other through translation. Thus, the data must be adjusted when character-lengths differ between the ST and TT if we are to conduct a fair comparison.

To test the null-hypothesis of zero difference between the Group S and Group T data (assuming 'equivalent' cognitive effort), paired Welch unequal-variance *t*-tests (1947) were carried out for each measure and each AOI, in conjunction with Cohen's *d*

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[2] The chart legends in the 'Results' section below stipulate the number of participants included in each AOI's sample (*n*).

effect size measurements (1962; with the adjustment in Hedges and Olkin, 1985, p. 81) to detect and measure differences between the datasets.

Results

These results describe the relationship between the two groups for each AOI. Since increased fixation durations (FFD, GD and TFD) are indicative of higher levels of cognitive effort, this method compares the effort reflected in the eye-tracking data for Groups S and T to consider whether an equivalent effect has been achieved. Full reporting data and descriptive statistics are provided in Appendix 2.

AOI-A: Doukipudonktan / Howcanaystinksotho

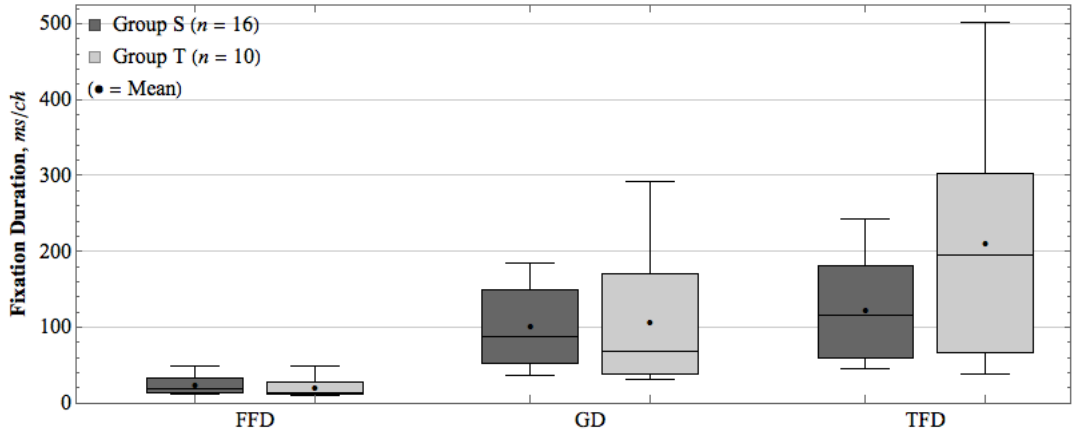

Figure 1. AOI-A fixation data

The FFD data for AOI-A show that the initial impact of this concertina-word was similar for Groups S and T ($p = 0.492$, $d = 0.28$). This trend remains for the GD data, suggesting that the first-pass reading experience was also largely equivalent ($p = 0.733$, $d = -0.15$). However, the TFD data suggest that Group T regressed to this AOI more than Group S ($p = 0.093$, $d = -0.84$), implying that the effect of this concertina-word on overall cognitive effort was higher for Group T, which is surprising, given that the 'severity' of orthographic manipulations in the TT is far lower than in the ST.

AOI-B: Skeutadittaleur / Wottusaidjusnow

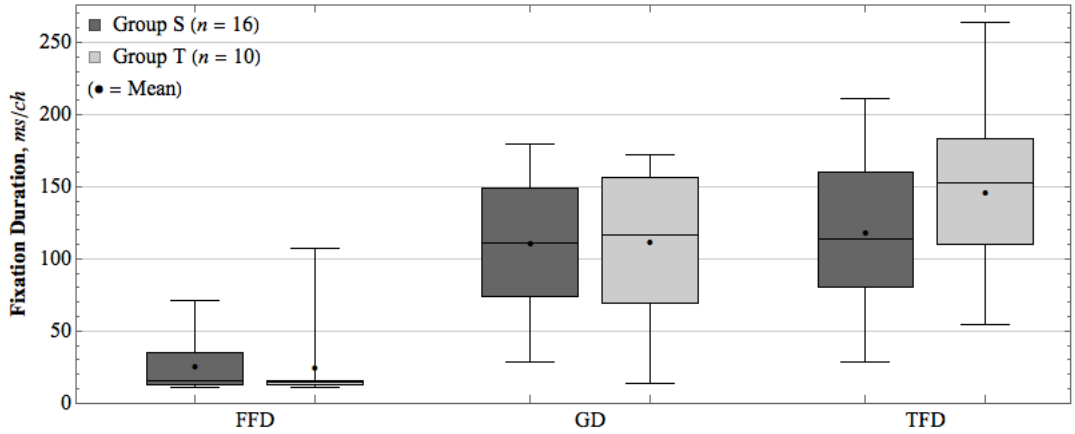

Figure 2. AOI-B fixation data

As predicted from the equal prevalence of orthographic manipulation in the ST and TT, the AOI-B data do not point to a significant difference between Group S's and Group T's cognitive effort in initial (FFD) or first-pass (GD) processing of this concertina-word (p = 0.897, d = 0.06 and p = 0.971, d = -0.01, respectively). Like AOI-A, however, the TFD data for Group T pointed to a higher level of cognitive effort on subsequent passes, although the size of the effect was only moderate (p = 0.263, d = -0.48).

AOI-C: Ltipstu / The chapshutistrap

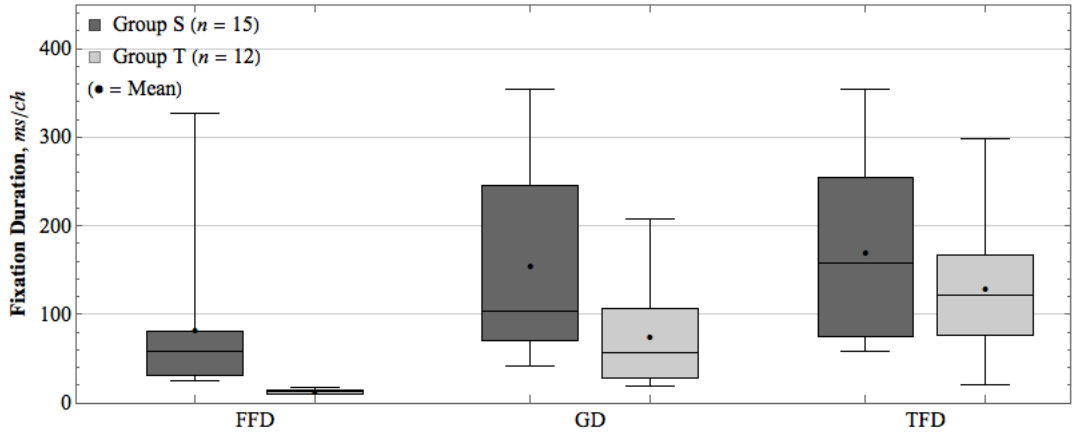

Figure 3. AOI-C fixation data

The FFD data clearly reveal a significant difference between the initial cognitive impact of the ST and TT ($p = 0.006$, $d = 1.09$), probably because the ST comprises the concertina-word itself, while the high-frequency determiner *the* is the first word of the TT AOI. The difference in first-pass processing (GD) was also significant ($p = 0.015$, $d = 0.93$), likely due to the elision and letter substitution present in the ST being more marked than the removal of *h-* from *his* in the TT concertina-word. Interestingly, there was no substantial increase in fixation durations from GD to TFD for Group S, unlike Group T, whose central tendency nearly doubled, resulting in only a moderate difference between Groups S and T ($p = 0.245$, $d = 0.43$).

AOI-D: Immbondit dssus / he pounced on me

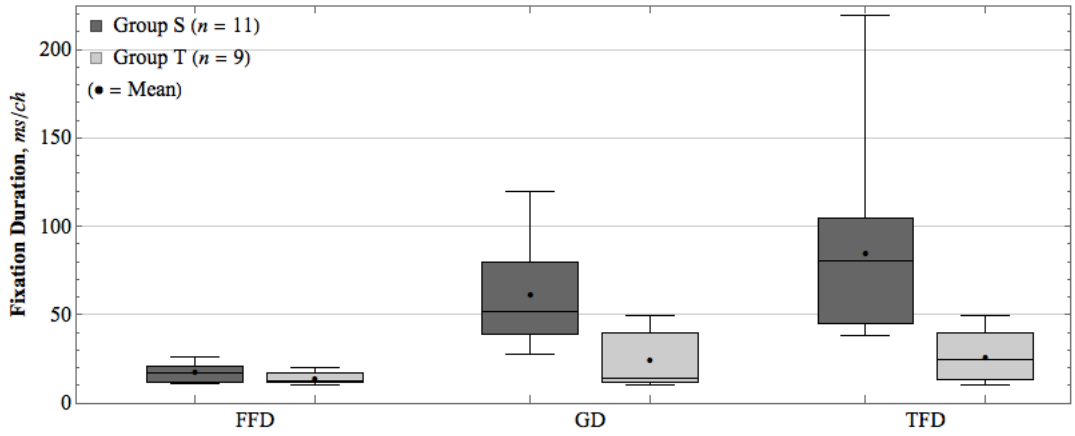

Figure 4. AOI-D fixation data

Contrary to what a stylistic analysis might suggest, the difference between the FFD data for Groups S and T was only moderate ($p = 0.139$, $d = 0.64$), despite the contrast between the ST concertina-word and the initial, high-frequency *he* in the TT phrase. However, when the first-pass data are compared (GD), Group S exhibits a significantly a higher average GD and TFD than Group T ($p = 0.004$, $d = 1.38$ and $p = 0004$, $d = 1.37$, respectively), presumably due to the contrasting effects of the ST's misspelling, letter substitution and elision and the unmarked language in the TT, which

required no heightened cognitive effort to process.

AOI-E: Isrelève / He gets up again

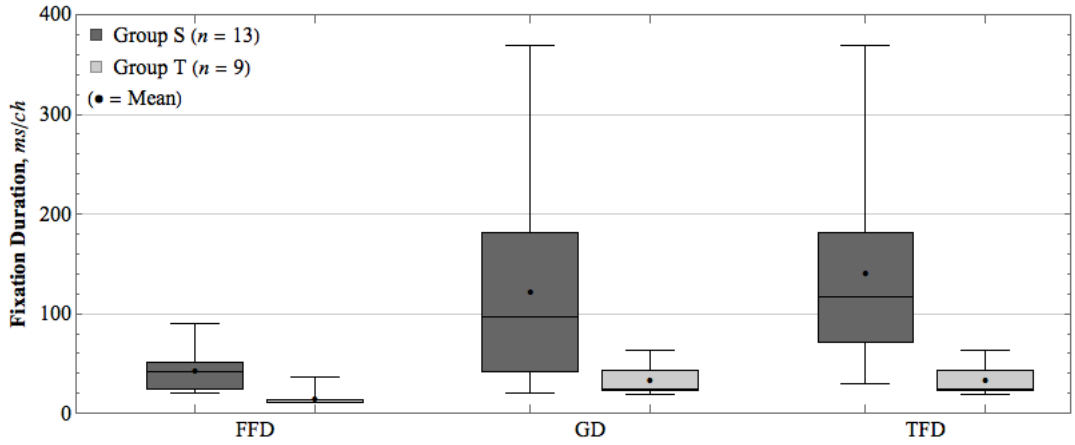

Figure 5. AOI-E fixation data

Unlike AOI-D, for AOI-E, the difference between Groups S and T was highly significant in the FFD ($p = 0.001$, $d = 1.48$), GD ($p = 0.012$, $d = 1.02$) and TFD ($p = 0.002$, $d = 1.34$) data. It would seem that the low-frequency word-initial consonant cluster in the ST (*Is*-), combined with the elision and subsequent compounding of *i(l) s(e) relève*, resulted in perceptibly higher cognitive effort for Group S readers, compared with the TT's unmarked, high-frequency language. This is a clear case where 'equivalent effect' has not been achieved.

AOI-F: jitrouas / post-war generation

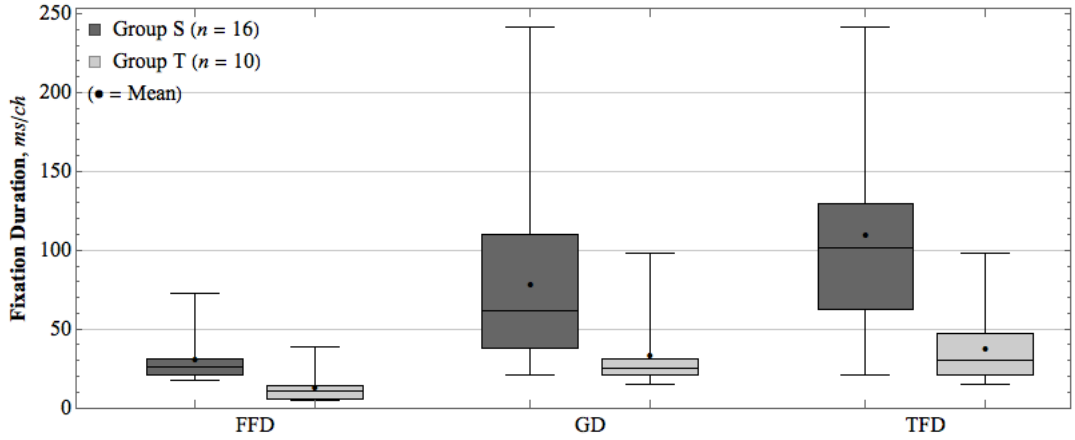

Figure 6. AOI-F fixation data

Not surprisingly, the cognitive effort exerted by Group S was significantly higher than Group T, in terms of initial impact (FFD: $p = 0.001$, $d = 1.26$), first-pass processing (GD: $p = 0.011$, $d = 0.92$), and subsequent passes (TFD: $p < 0.001$, $d = 1.39$). The complexity of *jitrouas* clearly required considerable cognitive effort for Group S to integrate. It is to be expected that the translation could not have achieved an equivalent effect here, for the reasons discussed above.

AOI-G: bloudjinnzes / blewgenes

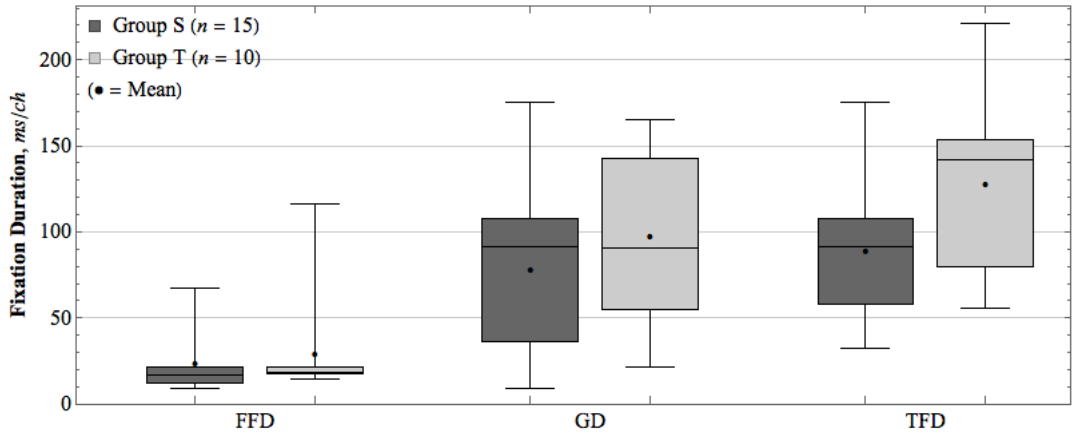

Figure 7. AOI-G fixation data

The FFD data for AOI-G suggest that the initial cognitive impact of the ST and TT was

largely similar ($p = 0.598$, $d = -0.24$), with the GD data also pointing to a comparable level of cognitive effort ($p = 0.377$, $d = -0.36$). Finally, the TFD data show that the difference between the experience of Groups S and T is arguably significant ($p = 0.054$, $d = -0.88$). While the ST employs substantial letter substitution to reflect phonetic codes, the TT employs two 'valid' homophonic morphemes in English – *blew* and *genes* – for their phonic qualities, as opposed to their referential meaning (on the reading of incorrect homophones, see Rayner, Pollatsek, & Binder, 1998). Their processing was likely further aggravated by the formation of the novel compound. The heightened GD and TFD for Group T, over those of Group S, may also have been caused by plausibility factors (see Rayner, Warren, Juhasz, & Liversedge, 2004), namely that the combination of these morphemes in a contextually and linguistically implausible manner may have resulted in increased cognitive effort for Group T.

Discussion

While the seven AOIs discussed in this paper present only some of the results obtained in this proof-of-concept study, they offer ample opportunity to discuss a number of general findings and methodological considerations.

The findings reinforced those presented in eye-tracking literature regarding longer fixations over the features identified in Queneau's concertina-words: orthographic manipulation, misspelling, compounding, and novelty, among others. In those AOIs where an equivalent concertina-word was replicated in the TT using orthographic transformations of a similar severity (AOI-A and -B), the eye-tracking data supported the hypothesis that the ST and TT would be experienced in a *broadly* similar manner, with comparable FFD, GD and TFD data. In the case of AOI-C, where a concertina-word was used in the TT, but the TT's orthographic manipulation was not nearly as marked, the FFD, GD and TFD reflected this reduced effect. With regard to

AOI-D, -E and -F, where the TT did not employ an equivalent strategy in rendering the foreignness present in the ST, the difference between the cognitive effort manifested in the data for Groups S and T was patently clear: Group S exhibited significantly longer fixation durations than did Group T, who did not need to exert any special cognitive effort to read high-frequency, normative language. Finally, AOI-G provided an interesting example of a case where the translation achieved a largely similar cognitive effect to the ST, but resulted in more intense levels of later-stage processing, reflected in the TFD data, likely due to the implausible combination of two contextually mismatched morphemes in a novel compound form. These findings largely mirror what most stylisticians would have predicted in a qualitative analysis of these segments, but allow for a more precise analysis of the various stages of reading comprehension and the 'choreography of effects' as a whole (Scott, 2000, p. 185). Though the findings may be predictable, this should not diminish the value or worth of this study, given that so little attention has been paid in TS to gathering data focusing on the actual reception of translations, let alone *compared with* their STs.

While eye-tracking methods do not tell us precisely *what* a reader is thinking, they can nonetheless offer a valuable insight into the influence of certain stylistic features on a reader's cognitive experience. Stylisticians have long acknowledged that certain cognitive effects can be achieved by creating 'processing difficulties' for the reader (Pilkington, 1996, p. 158). Hence, eye tracking allows an extension of this theoretical assumption in stylistics to something more tangible and quantifiable. A critic cannot be *certain* of the effect of a stylistic device on readers. Therein lies the problem of traditional criticism: its inherent *subjectivity*. There have been empirical attempts to explore textual effects of actual readers in other fields, such as 'psychonarratology', which acknowledges that 'how readers process narrative is essentially an empirical

question that can only be answered by systematic observation of actual readers reading actual texts', as opposed to 'intuition, anecdotal evidence' or 'models of human experience' (Bortolussi and Dixon, 2003, p. 13). The method proposed in this paper is an attempt to bring this concern for empiricism into translation reception studies.

By comparing the presumed cognitive effort of ST and TT readers at specific, highly marked stylistic points in their respective texts, and by drawing on what can be learnt from existing eye-tracking research on reading such forms (letter transposition/substitution, misspellings, etc.), we can start to build a cognitively-oriented model of the long-standing, and widely debated, notion of equivalent effect. Such a model should prompt translators to be more aware of their own experience of reading the ST and, in turn, the possible experiences of others when reading their translation. Being a proof-of-concept, the aim of this study was to prove that the methods that have become increasingly ubiquitous in process-oriented spheres of TS and audiovisual translation, and have been commonplace in cognitive psychology for decades, can be fruitfully reapplied to compare cognitive aspects of the reading experience of the ST and TT using real readers. It therefore adds a novel, empirical dimension to previous discussions of equivalence in translation.

Concluding remarks

This article has discussed preliminary findings from a proof-of-concept eye-tracking study looking to test some of the expectations surrounding marked stylistic devices in terms of their cognitive effects on readers. The findings, based on a quasi-experimental design focusing on the translation of 'concertina-words', show the growing potential for innovative contributions to stylistic approaches to literary translation and to empirical TS, both of which have largely neglected the reception of translation products (see Hvelplund, 2017; H. Kruger and Kruger, 2017; Shreve and Lacruz, 2017). The broader

research questions broached in this paper also lead to some interesting conclusions regarding the neutralisation of foreignising ST elements, such as language varieties, in translation, allowing the 'loss' in equivalent effect to be confirmed and quantified in the case of three of the examined AOIs, as opposed to mere conjecture about *possible* effects on readers.

This methodological approach provides researchers with a framework on which to base future studies of this kind, to further develop the method proposed here, and to test some of the tentative conclusions derived from this preliminary study. The method adopted in this experiment is not without its flaws, however: corpus-based approaches to determining word frequency would allow for greater factorial control and modelling of the experiment data, for example. The use of additional, purposely neutralised variants of each text (ST and TT) would also provide further opportunities for comparison of the effects of marked and unmarked styles and exploration of other factors affecting the reading experience[3]. Furthermore, as with any experiment involving human participants, the recruitment of additional participants would have been beneficial for greater statistical power[4].

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[3] While an intentionally neutralised version of the TT was produced and used in this experiment, the results from this third group of participants, who read an alternative version of the TT, warrant more in-depth discussion, going beyond the scope of this paper, and will be discussed in a separate forthcoming publication.

[4] With an alpha level of 0.05, sample groups of 17 and 14, and the use of a large effect size threshold of $d = 0.08$, the achieved power for this study was only 0.57. In order to achieve the preferable level of > 0.8, group sizes of 26 in each group would have been necessary.

Nonetheless, from the results obtained and the coherence of the data with recognised findings in eye-tracking literature, there are clear merits to this approach and its potential for other forms of marked style. All that remains is to invite other researchers to test and develop the tentative methods set out in this proof-of-concept, and to further explore the empirical opportunities that this approach can offer to TS.

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Appendix 1: AOIs in context

	ST AOI in context	TT AOI in context
AOI-A	**Doukipudonktan**, se demanda Gabriel excédé. Pas possible, ils se nettoient jamais. Dans le journal, on dit qu'il y a pas onze pour cent des appartements à Paris qui ont des salles de bains, ça m'étonne pas, mais on peut se laver sans.	**Howcanaystinksotho**, wondered Gabriel, exasperated. Ts incredible, they never clean themselves. It says in the paper that not eleven percent of the flats in Paris have bathrooms, doesn't surprise me, but you can wash without.
AOI-B	– Tu pues, eh gorille. […] – Répète un peu voir, qu'il dit Gabriel. Un peu étonné que le costaud répliquât, le ptit type prit le temps de fignoler la réponse que voici: – Répéter un peu quoi ? Pas mécontent de sa formule, le ptit type. Seulement, l'armoire à glace insistait: elle se pencha pour proférer cette pentasyllabe monophasée: – **Skeutadittaleur**...	'You stink, you gorilla.' […] 'Say again,' says Gabriel. A bit surprised that the stalwart should answer back, the little chap took his time, and concocted the following reply: 'Say what again?' Not displeased with his turn of phrase, the little chap wasn't. Only the great hulk didn't let up, it leant over him and uttered this monophasic pentasyllable: '**Wottusaidjusnow**.'
AOI-C	**Ltipstu** et Zazie reprit son discours en ces termes : – Papa, il était donc tout seul à la maison, tout seul qu'il attendait, il attendait rien de spécial, il attendait tout de même, et il était tout seul, ou plutôt il se croyait tout seul, attendez, vous allez comprendre.	**The chapshutistrap** and Zazie resumed the conversation in these terms: 'So he was all by himself at home, then, my old man, he was waiting all by himself, he wasn't waiting for anything special, he was just waiting, and he was all by himself, that's to say he thought he was all by himself, hang on a minute and you'll see what it's all about.
AOI-D and **AOI-E**	[…] lui il saute sur la porte et il la ferme à clé et il met la clé dans sa poche et il roule les yeux en faisant ah ah ah tout à fait comme au cinéma, c'était du tonnerre. Tu y passeras à la casserole qu'il déclamait, tu y passeras à la casserole, il bavait même un peu quand il proférait ces immondes menaces et finalement **immbondit dssus**. J'ai pas de mal à l'éviter. Comme il était rétamé, il se fout la gueule par terre. **Isrelève**. Irecommence à me courser, enfin bref, une vraie corrida. Et voilà qu'il finit par m'attraper.	he flings himself on to the door and he locks it and he puts the key in his pocket and he rolls his eyes and he goes aha just like they do in the movies, it was terrific. You've got it coming, he kept shouting, you've got it coming, he was even frothing at the mouth a bit as he uttered these unspeakable menaces, and finally **he pounced on me**. It was dead easy to dodge him. He was plastered and so he fell flat on his face. **He gets up again**, he starts chasing me again, to make a long story short, a real bull-fight. And then, here, he finally catches me.
AOI-F and **AOI-G**	Lui arrachant le pacquet méchamment, il se mit à la secouer en proférant avec énergie les paroles suivantes : – Tu n'as pas honte, petite voleuse, pendant que j'avais le dos tourné. Il fît ensuite appel à la foule s'amassant : – Ah ! les **jitrouas**, rgardez-moi cqu'elle avait voulu mfaucher. Et il agitait le pacson au-dessus de sa tête. – Une paire de **bloudjinnzes**, qu'il gueulait. Une paire de bloudjinnzes qu'elle a voulumfaucher, la mouflette.	Maliciously snatching the parcel from her he started shaking her, energetically pronouncing the following words: 'Aren't you ashamed of yourself, you little thief, while I'd got my back turned.' He then appealed to the gathering crowd: 'Ah! the **post-war generation**, just have a look what she tried to pinch from me.' And he waved the parcel about over his head. 'A pair of **blewgenes**,' he yelled. 'A pair of blewgenes she tried to pinch from me, this little creature did.'

Appendix 2: Reporting data

AOI	Measure	Group S						Group T						Mean difference	95% CI		*t-test*			*d*	95% CI	
		n	Mean	Median	SD	Min	Max	n	Mean	Median	SD	Min	Max		Lower	Upper	*t*	*df*	*p*		Lower	Upper
	FFD		23.81	19.54	12.14	11.43	48.79		20.26	13.81	12.84	9.28	48.89	3.55	-7.08	14.18	0.701	18	0.492	0.28	-0.52	1.07
A	GD	16	94.05	87.96	59.05	20.50	185.21	10	105.35	68.22	91.36	31.67	292.06	-11.30	-81.01	58.40	-0.348	14	0.733	-0.15	-0.94	0.64
	TFD		115.36	115.32	72.74	20.50	242.86		210.80	195.39	154.37	38.00	500.94	-95.43	-209.44	18.58	-1.832	12	0.093	-0.84	-1.66	-0.01
	FFD		25.44	15.80	19.97	10.47	70.87		24.05	14.47	29.50	10.67	107.33	1.40	-21.26	24.06	0.032	14	0.897	0.06	-0.73	0.85
B	GD	16	110.68	111.10	45.63	28.67	179.27	10	111.42	116.23	51.48	13.80	171.80	-0.74	-42.59	41.12	-0.037	17	0.971	-0.01	-0.80	0.78
	TFD		118.10	113.47	51.52	28.67	211.13		145.69	152.57	63.25	54.87	263.73	-27.59	-77.94	22.76	-1.160	16	0.263	-0.48	-1.28	0.33
	FFD		82.30	59.00	82.70	24.71	327.57		12.68	12.86	2.43	9.83	17.78	69.62	23.81	115.44	3.259	14	0.006	1.09	0.28	1.90
C	GD	15	154.70	104.29	100.71	41.86	354.71	12	73.68	56.56	58.29	19.06	207.94	81.03	16.96	145.09	2.616	23	0.015	0.93	0.13	1.73
	TFD		169.82	157.57	100.37	59.00	354.71		129.28	122.22	76.31	20.94	298.89	40.54	-29.52	110.59	1.192	25	0.245	0.43	-0.33	1.20
	FFD		17.25	16.87	5.46	11.13	26.20		14.08	12.31	3.66	10.19	19.81	3.18	-1.14	7.49	1.551	17	0.139	0.64	-0.26	1.54
D	GD	11	61.10	52.00	31.06	28.00	119.80	9	24.36	14.38	16.00	10.19	49.94	36.74	13.83	59.64	3.409	16	0.004	1.38	0.40	2.36
	TFD		84.55	80.73	52.95	38.47	219.67		26.10	24.63	15.09	10.63	49.94	58.45	21.96	94.94	3.492	12	0.004	1.37	0.40	2.35
	FFD		42.32	41.63	22.08	20.00	90.00		14.72	11.25	8.53	10.44	36.44	27.60	13.32	41.87	4.087	17	0.001	1.48	0.52	2.44
E	GD	13	122.28	96.63	107.09	20.00	368.75	9	33.65	25.00	14.84	18.56	63.06	88.64	23.41	153.87	2.944	13	0.012	1.02	0.12	1.92
	TFD		140.92	117.50	98.57	29.63	368.75		33.65	25.00	14.84	18.56	63.06	107.28	47.16	167.41	3.862	13	0.002	1.34	0.40	2.28
	FFD		30.86	25.81	15.84	17.50	72.88		12.77	10.95	9.83	5.11	38.58	18.09	7.71	28.48	3.595	24	0.001	1.26	0.40	2.12
F	GD	16	77.81	61.44	55.84	20.88	241.25	10	33.35	24.92	24.69	14.74	98.26	44.46	11.31	77.61	2.780	22	0.011	0.92	0.09	1.75
	TFD		109.21	101.88	60.56	20.88	241.25		37.04	30.11	24.55	14.74	98.26	72.18	36.84	107.51	4.242	21	0.000	1.39	0.52	2.27
	FFD		23.15	16.92	18.28	8.92	67.50		29.00	18.33	30.83	14.78	116.22	-5.85	-29.21	17.51	-0.540	13	0.598	-0.24	-1.04	0.57
G	GD	15	78.04	91.58	48.50	8.92	174.92	10	96.91	90.72	52.60	21.89	165.44	-18.87	-62.56	24.82	-0.906	18	0.377	-0.36	-1.17	0.44
	TFD		88.89	91.58	36.95	32.50	174.92		127.58	142.00	50.32	56.00	221.00	-38.69	-78.15	0.78	-2.085	15	0.054	-0.88	-1.71	-0.04