# Onomatopoeia: A relevance-based eye-tracking study of digital manga

Olivia Rohan [1], Ryoko Sasamoto[*], Sharon O'Brien

*School of Applied Language and Intercultural Studies, Centre for Translation and Textual Studies, Dublin City University, Glasnevin, Dublin, Ireland*

ABSTRACT

This study is concerned with the reception of onomatopoeia in the English translation of digital manga. In manga, onomatopoeia is often presented as part of the aesthetics, being both verbal (*meaning*) and non-verbal (*showing*) simultaneously. Drawing on the relevance-theoretic notion of a *showing-saying* continuum (Sperber and Wilson 1995), this study aims to identify factors that affect reading behaviour including the translation strategies and the degree of the *showing/meaning* ness. We conducted an eye-tracking study to gain empirically supported insight into readers' interaction with onomatopoeia in manga. Findings of this study show that full-textual substitution, which is the hybrid of *showing-meaning*, attracts most interest and is the area that receives most attention when compared with annotation or the Japanese original. This in turn indicates that the degree of *showing*-ness of onomatopoeia influences the way readers interact with onomatopoeia in manga. The conclusion is that separating the *showing* and *meaning* elements of onomatopoeia in manga could result in a loss of engagement potential with readers, and full-textual substitution would be the recommended translation strategy for the best level of attention.

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## 1. Introduction

Manga is the Japanese form of comic book literature. As with Western comic books, it is a mix of illustration and texts in panel format conveying action and time, with text used to convey dialogue, thoughts, and narration. While Western comics are predominantly driven by the superhero genre, manga is used across genres often determined by the demographics of target readers. For example, the target demographic for *shojo* manga would be young girls while *shonen* manga would target young boys. Similarly, the target for *seinen* manga would be adult readers. Manga is also used for adverts, textbooks, or even for official guidebooks/PR documents published by governments.

Onomatopoeia, generally, is a linguistic form that is used to mimic sound. A typical example in English is *bang* or *crunch*. However, as we have argued elsewhere (Sasamoto and Jackson, 2016; Rohan et al., 2018; Sasamoto, 2019), onomatopoeia could also be used to mimic non-sound-based impressions, such as texture, manner, or even feelings. These are particularly prevalent in Japanese and examples include *dokidoki* (excited or nervous state of mind), *shīn* (silence) or *petapeta* (stickiness).

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* Corresponding author.
*E-mail addresses:* ryoko.sasamoto@dcu.ie (R. Sasamoto), sharon.obrien@dcu.ie (S. O'Brien).
[1] Independent Researcher.

In this study, onomatopoeia is defined as a linguistic form that is used by virtue of resemblance between its phonological form and the associated object regardless of the sound-based nature.

The use of onomatopoeia is said to be one of the defining features of manga (McCloud, 1993; Eisner, 2008; Petersen, 2009; Cohn, 2014). Onomatopoeia in manga is often used to portray non-dialogue sounds, such as action, background noise, and related diegetic effects, presented in highly stylised fonts embedded in aesthetics, which are different to the typeface used in speech bubbles and narrative text.[2]

Translating onomatopoeia is already challenging because, for example, its degree of use varies across languages and there appears to be a close linkage between the form and the meaning; this aesthetic use of onomatopoeia in manga makes its translation even more challenging. With the advancement of digital publishing, manga started to spread into a digital space, which enabled publishers to have worldwide 'day-and-date' publication where manga can be released simultaneously worldwide (Simulpub). To achieve Simulpub, the original Japanese content must be translated in a very tight turnaround time. As a result, certain elements of manga, such as dialogues in speech bubbles and narratives, have to be prioritised for translation. Given that onomatopoeia is an integral part of the aesthetic of a page, a new language version requires redrawing of the page and this, therefore, counts as more work-intensive translation, which is often reserved for a special collectors' edition to be published later.

There are typically four strategies to translate onomatopoeia in manga with two strategies dominating the simulpub (same-time publication across different languages) and collectors' items. The first strategy is annotation, which typically takes the form illustrated in Fig. 1. The annotation is a translated word in the target language (typically English), presented in a very small font positioned in proximity to, or within the boundary of, the original Japanese onomatopoeia (as marked with a red circle in Fig. 1). In this study, this translation strategy is called *annotation with the Japanese original* (AJO). The second one is full-textual substitution (FTS), which is the most graphically effortful form of translation, as seen in Fig. 2. In this instance, the Japanese onomatopoeia is erased from the page and substituted with typographic replica in the target language (typically English). FTS is most commonly used in the collectors' editions. The other two strategies, which are less prevalent, include non-translation, where no annotation is given and the onomatopoeia in Japanese is left as is, and a glossary, which is the list of all of the translated onomatopoeia given in a separate section of the manga, usually towards the end of the publication as an appendix.
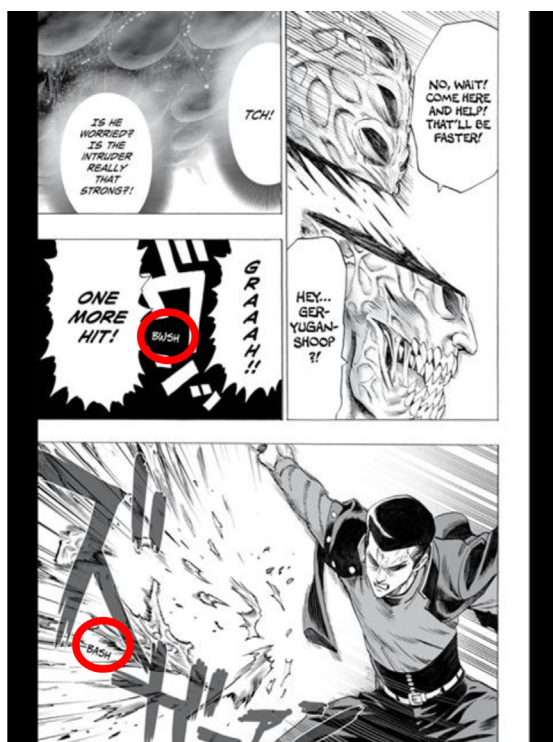


**Fig. 1.** Strategies of translating onomatopoeia (annotation with the original Japanese), *One-Punch Man*, page 9, Chapter 33 (VIZ Media Shonen Jump digital vault edition). ONE-PUNCH MAN © 2012 by ONE, Yusuke Murata/SHUEISHA Inc.

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[2] There is a rich body of literature on the development of onomatopoeia research. See Akita and Dingemanse (2019) for a fuller discussion.

**Fig. 2.** Strategies of translating onomatopoeia (Full Textual Substitution), *One-Punch Man*, page 135, Chapter 33, vol. 6 (VIZ Media Shonen Jump Graphic Novel edition). ONE-PUNCH MAN © 2012 by ONE, Yusuke Murata/SHUEISHA Inc.

While the choice of translation strategy seems to be at the mercy of the publisher's economic costing, it is reasonable to assume that radically different presentations of onomatopoeia through translation would certainly affect the readers' experience. Furthermore, the hybrid nature of onomatopoeia in manga, being part linguistic and part aesthetic, also has an implication for pragmatics, as readers would interpret onomatopoeia in manga as a single communicative unit, in which the artist can merge image and words to convey their intention. Against this backdrop, this study is an attempt to gain theoretically founded, empirically supported insight into whether different translation strategies for onomatopoeia affects readers' engagement and/or interaction with onomatopoeia. To address this objective, we conducted eye-tracking experiments and analysed the findings in terms of the Relevance-theoretic notion of the *showing-meaning* continuum. It is hoped that the experimental approach taken in this study will also contribute to the empirical application of Relevance Theory which, to the best of the authors' knowledge has not been discussed extensively.

We will begin by reviewing studies of onomatopoeia in manga in Section 2.1 before introducing a relevance-theoretic analysis of onomatopoeia and onomatopoeia in manga in Section 2.2. We will then turn to reception studies on manga in Section 2.3. Section 3 will present the research design and the methodology of the current study. Findings from our eye-tracking experiments will be presented in Section 4. Finally, in Section 5, we will examine the findings from the perspective of Relevance Theory to address the aims mentioned above.

## 2. Literature review

### 2.1. Onomatopoeia in manga

As one of the key elements of manga, onomatopoeia has attracted considerable scholarly attention (c.f. Kusamori, 1968, cited in Natsume, 2013; McCloud, 1993; Eisner, 2008; Petersen, 2009; Natsume, 2013; Cohn, 2014; Guynes, 2014). It is generally considered that onomatopoeia emphasises the impact of what is depicted within the manga page as sound effects (SFX), be it explosions, punches, or vocalisation such as coughs and grunts (Guynes, 2014). For example, the onomatopoeia *pow* inserted in the aesthetics would show the strength of the impact made by the punch depicted in the scene. This way, onomatopoeia is an integral part of the storytelling of manga and creates dynamics and atmosphere (c.f. Schwartz and Ribinstein-Ávila, 2006). And indeed, many scholars point at the role onomatopoeia in manga plays in terms of intensifying and emphasising the narrative (e.g. Itoi, 1989; Fukuma, 1993; Sasamoto, 2000; Tajima, 2006; Petersen, 2009; and Morooka, 2010). Jun Sasamoto (2000, 16, cited in Natsume, 2013, authors' translation) also argues that aesthetics of onomatopoeia allow for creativity, as they 'synaesthetically communicate the tone, emotional nuance, or the sense of speed', communicating something words alone cannot express fully.[3]

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[3] The role of onomatopoeia in manga is also discussed in terms of the signifier and signified (c.f. Casas-Tost, 2014 and Guynes, 2014, or Nida's (1964) continuum of formal and dynamic equivalence in translation (c.f. Jüngst, 2004, 2007).

The marriage between verbal and aesthetic features is central to studies on onomatopoeia in manga and a number of scholars address this verbal-aesthetic balance. McCloud (2006) describes this link in the quote below, explaining techniques such as utilising size, the thickness of lines, tilt, and punctuations used by comic artists to create SFX effectively:

> Thanks to film and television, we've gotten used to stories that continuously use **sight** and **sound** and offer rich, immersive experiences. But as comics [sic] creators, if we want to **reproduce** that kind of experience, we need to do it using only **one** sense. Words play an important role in comics by **bridging** that gap. They give **voice** to our characters, allow us to describe all **five** senses–and in the case of **sound effects**, they graphically **become** what they describe– BANG!–and give readers a rare chance to **listen**–with their **eyes**.

(McCloud, 2006, 146, original emphasis)

In other words, onomatopoeia in manga, which is part of the aesthetics, functions like a glue which brings images and language together. In doing so, it could allow for the communication of sensory experience which cannot be conveyed otherwise, such as nuances and impressions of the scene. This is because the onomatopoeia delivers to the reader what would be perceived via different sensory channels if the action was to take place physically in front of them. For example, the onomatopoeia *pow* could be displayed in a thick line with a large font to communicate a strong punch. Or, it could be drawn with a thin line to express the weakness of the punch. This feature of onomatopoeia in manga makes translation challenging and indeed, these challenges have been widely discussed by researchers such as Kaindl (1999), Jüngst (2004, 2007), Petersen (2009) and Schodt (1996).[4] Drawing on Delabastita (1989) film translation strategies, Kaindl (1999) explores the translation of manga and presents different strategies that can be adopted and argues that onomatopoeia could be translated using the strategies of *addition*, (or annotation as it is called in this study), *substitution* and in rare cases, *transmutation*.[5] Similarly, Sell and Pasfield-Neofitou (2015) conduct a corpus analysis of onomatopoeia in manga and its translation.[6] Their findings show that the dominant translation strategies used by major publishing companies include substitution (39%), followed by repetition (or *non-translation*) (29%), and addition[7] (23%).[8]

If onomatopoeia in manga, embedded in aesthetics, plays a crucial role in manga, as agreed in previous studies we have reviewed so far, and if translation of onomatopoeia involves a number of different translation strategies, it would pose a unique challenge for a theory of communication, especially to identify a strategy best suited for readers to interpret onomatopoeia. In particular, this study seeks to answer the following questions: do different translation strategies for onomatopoeia demand different levels of attention and cognitive load? If so, how could a theory of pragmatics help explain why such differences arise?

In the next section, we will present an overview of existing relevance-theoretic analysis of onomatopoeia and onomatopoeia in manga.

### 2.2. Onomatopoeia and relevance

Relevance theory is a cognitively grounded theory of communication, which provides an explanatory framework for human communication. Relevance theory is centred around two Principles of Relevance. The first, Cognitive Principle of Relevance, describes how our cognition is designed in such a way that humans pay attention to what is likely to produce some reward:

(1)   Human cognition tends to be geared to the maximisation of relevance.
(Sperber and Wilson, 1986/1995, 260)

Relevance is defined as a balance between the processing cost and cognitive effects with which the hearer would be rewarded. Cognitive effects can be seen as an adjustment to our cognitive environment (the way individuals represent the world). Other things being equal, the more cognitive effects a stimulus has, the more relevant it is. Similarly, other things being equal, the less effort involved in the processing of a stimulus, the more relevant it is.

Humans' cognitive tendency as described above leads to the second, Communicative Principle of Relevance, which explains why and how communication works:

(2)   Every act of ostensive communication communicates a presumption of its own optimal relevance.
(Sperber and Wilson, 1986/1995, 260)

That is, when the speaker draws the hearer's attention by presenting an ostensive communicative stimulus, the hearer can expect that they should have a good reason to do so and the hearer's processing effort will not be wasted and hence is worth processing. This is termed the Presumption of Optimal Relevance.

Optimal relevance is defined as follows:

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[4]  Scholars in translation studies (c.f. Flyxe, 2002; Inose, 2008; Bartashova and Sichinskiy, 2014) have long argued that onomatopoeia is considered a challenge for translators. Amongst reasons given are the lack of equivalence and differences in style and register and phonetic systems between languages.

[5]  *Transmutation* is also known as *intersemiotic translation*, which is a translation of 'verbal signs by means of signs of nonverbal sign systems' (Jakobson, 1971: 114).

[6]  Their findings are available at http://mangastudies.com/sfx/about.php. Accessed 18 May 2018.

[7]  In this study, we label non-translation as *Japanese original* while *addition* is called *annotation*.

[8]  One of the issues with translating manga is the difference in style between Japanese and Western-style comics. See Guynes (2014), Schodt 1983; Pratha et al. 2016) for a fuller discussion.

(3)   An ostensive stimulus is optimally relevant to an audience if:
a.    It is relevant enough to be worth the audience's processing effort;
b.    It is the most relevant one compatible with the communicator's abilities and preferences.
                                                    Sperber and Wilson (1986/1995, 260–278)

As Relevance Theory explains, ostensive-inferential communication necessarily involves two layers of intention: the informative intention and the communicative intention:

Ostensive Inferential Communication

a.    The informative intention:
      The intention to inform an audience of something.
b.    The communicative intention:
      The intention to inform the audience of one's informative intention.
                                                    (Wilson and Sperber 2004:611)

Putting this in terms of information, Wharton (2008:16) explains that '[t]he first, basic layer is the information being pointed out, and the second is the information that the first layer is being pointed out intentionally.' When the communicator produces ostensive communicative stimuli, they present evidence to the first layer of communication. The fact that the communicator provides evidence for communication creates a presumption of optimal relevance, and upon recognising an ostensive communicative stimulus (or recognising the evidence provided by the communicator), the hearer would search for relevance following the relevance-theoretic comprehension procedure:

(4)   the relevance-theoretic comprehension procedure:
      a. Follow the path of least effort in deriving cognitive effects: test interpretive hypotheses (reference assignments, disambiguations, implicatures, etc.)
         in order of accessibility.
      b. Stop when your expectations of relevance are satisfied.
                                                    (Sperber and Wilson 2002, 24)

In explaining how and why communication works, Relevance Theory does not make any special case for verbal or non-verbal communication. Instead, Relevance Theory assumes that the interpretation process is triggered by *any* ostensive communicative behaviour, including both verbal, non-verbal and naturally occurring behaviours (Sperber and Wilson, 1986/95; Wharton, 2009; Scott 2017). So, whenever a communicator makes their intention to communicate known to an audience and uses something — be it an utterance, facial expression, gesture, or combination of all of the above — to deliver such an intention, the hearer's interpretation process begins. This process is the same for any ostensive communicative stimuli, and therefore, in Relevance Theory, non-verbal (non-coded) communication is to be treated in the same way as verbal communication. This makes Relevance Theory particularly suitable for the analysis of onomatopoeia in manga, as onomatopoeia in manga necessarily involves verbal and non-verbal aspects of communication.[9]

Sasamoto and Jackson (2016), Rohan et al. (2018), Sasamoto (2019 have previously analysed onomatopoeia in terms of the relevance-theoretic notions of the *showing-meaning* continuum. *Showing* is a kind of communication where the speaker, instead of providing a verbal utterance, presents an alternative (often non-verbal) evidence, such as moving their fingers across the mouth to evoke the action of zipping to inform an audience that they have to keep something confidential. *Meaning*, on the other hand, involves producing an utterance, such as *Don't tell anyone*, which is verbal evidence for communication. Previously, *showing* and *meaning* aspects of communication were treated as a distinction. However, Wharton (2003, 2006, 2009) shows that the distinction between *showing* and *meaning* is a continuum. For example, one could move one's fingers across one's mouth to signal zipping and simultaneously say *Don't tell anyone*. Or, one could put on an angry voice and say *I'm cross with you*.

In his analysis of interjections in terms of the *showing-meaning* continuum, Wharton (2009) compared interjections and onomatopoeia and indicated that onomatopoeia, like interjections, could also involve both *showing* and *meaning* elements. Following on from this suggestion by Wharton (2009), Sasamoto and Jackson (2016) examined onomatopoeia in terms of the *showing-meaning* continuum and the notion of perceptual resemblance and argued that onomatopoeia necessarily involves both *showing* and *meaning* aspects of communication. It was argued that the *showing* aspect of onomatopoeia necessarily involves perceptual resemblance between the source experience and the phonological form of the expression. That is, by using onomatopoeia, the speaker can provide both direct (non-coded) and indirect (coded) evidence for communication or for the first layer of information (i.e., the information being pointed out) to be precise. The direct evidence (or the phonological form of the onomatopoeic expression in this case) resembles the perception of the experience the communicator wants to share with the audience in terms of the sound of the expression while the indirect evidence could involve linguistic representations (if the onomatopoeia is highly lexicalised). Take the expression *bang*. In an utterance 'the door banged shut',

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9   There has been some debate on the nature of onomatopoeia in comics, especially regarding the status of onomatopoeia in comics as a linguistic sign. Kowalewski (2015) on the one hand argues that onomatopoeia in manga should be distinguished from onomatopoeia in language for grammatical and syntactic reasons as well as the fact that the source of onomatopoeia in manga could include a non-human source. He even denies the iconic nature when it comes to onomatopoeia in manga. Körtvélyessy (2020) on the other hand argues that onomatopoeia, both in a strict sound-based sense and also in a broader sense as adopted in this study, is indeed rooted in language. While this debate is indeed interesting, it is not particularly relevant for the current study as our focus is on what humans communicate using onomatopoeia in comics, whether it is established as a lexicon and syntactically embedded or isolated. In this sense, Relevance theory is an ideal framework as both linguistic and non-linguistic aspects of onomatopoeia can be treated using the same theoretical architecture.

the phonological form of the word ′baŋ is provided as direct evidence and resembles the sensory experience of the impact, which in turn gives rise to impressions of the manner of the door closing. In contrast, its lexical entry *to strike sharply* is provided as indirect evidence and becomes a constituent of the proposition expressed. This way, the *showing* aspect of onomatopoeia, which provides direct evidence for communication, brings about a similar impression from a (different) sensory domain. Such direct evidence provides quick access to non-propositional effects that are communicated by virtue of perceptual resemblance to sensory-experience. This suggests that onomatopoeia is a human's exploitation of similarities between a phonological feature of expression and the source experience, allowing for the sharing of impressions, in addition to linguistic contents communicated via indirect evidence.

In Rohan et al. (2018), Sasamoto (2019), we argued that the *showing-meaning* continuum and perceptual resemblance could be extended to analyse onomatopoeia in manga. That is, as a lexical item, onomatopoeia involves the *showing* and *meaning* aspects. In addition to this, onomatopoeia in manga as part of an aesthetic has a further *showing* element via its visual presentations. This makes the meaning of onomatopoeia in manga even more complex, carrying direct evidence and indirect evidence as a lexical item as well as another layer of meaning via visual presentation. Such visual presentations might involve typeface, the thickness of the line, tilt, size, or the saturation of the colour. For example, Sasamoto (2019) showed how different presentations of the same onomatopoeia could give rise to different impressions using the same onomatopoeia of the siren *woooo* (ウウウ, siren noise) in an apocalypse scene. On one hand, the onomatopoeia is displayed in a thick line in a large font in a scene which depicts the approaching meteor and the area which will be the ground zero. In this scene, the use of strong aesthetics conveys the sense of urgency when a huge meteor is about to hit the earth. In a different scene, on the other hand, the same onomatopoeia is displayed but this time with a smaller font and less thick line. The focus of the scene is on people's shocked state rather than their impending doom. In this case, rather than the sense of urgency, the scene conveys a somewhat distant dream-like atmosphere where people are stood not knowing what is happening. Of course, it is not just the visual presentation of onomatopoeia that creates such a difference. Other elements such as the focus or the composition of the scene would also influence the interpretation. However, visual elements of onomatopoeia in manga are certainly used as further direct (or non-coded) evidence to communication, in addition to the *showing* and the *meaning* aspects of the onomatopoeia as a lexical item, which allows for the sharing of impression (or dynamics or atmosphere, as discussed in previous studies).

This way of understanding the role of onomatopoeia in terms of the relevance-theoretic notion of the *showing-meaning* continuum and perceptual resemblance enables us to *explain* the role of onomatopoeia in manga within a single cognitive framework. This study aims to provide empirical support for such theoretical discussions. In what follows, we investigate whether our theoretical analysis could be supported by empirical evidence.

## 2.3. Empirical approaches to onomatopoeia in manga

The orchestra of text and image makes comics and manga an ideal research object for reception studies. Indeed, there have been a number of studies that conduct eye-tracking experiments using comics as stimuli (c.f. Jain et al., 2012; Kunze et al., 2013; Augereau et al., 2016; Rigaud et al., 2016).[10] Researchers are often interested in the visual-storytelling aspect of comics and have conducted eye-tracking experiments with an aim to gain further understanding of the manga contents (Rigauld et al., 2016:120). However, as Foulsham et al. (2016) argue, most studies do not consider uncontrolled variables such as readers' bias, reading behaviour and manga/comic proficiency, and the multimodal nature of manga/comics. To address this, Foulsham et al. (2016) conduct eye-tracking experiments on comic strips using materials that are manipulated systematically to test reading behaviour. They evaluate how the (lack of) coherence would influence the readers' eye movements by manipulating the coherence of comic strips and by stripping down each manga cell to an individual image to minimise the interference from the multimodal stimuli commonly found in manga and comics. Foulsham, Wybrow and Cohn (2016) conclude that a lack of coherence in comic strips indeed influences reading behaviour, as the comic strips that involved disrupted coherence sequences required additional gaze time and regressions. This study is ground-breaking in that it empirically shows how the coherence of the narrative in visual storytelling affects readers' behaviour. However, their focus is very much on the narrative sequence, while the focus of this study is on onomatopoeia, which in fact is part of the multimodal stimuli that Foulsham et al. (2016) strip out of the stimuli.

Torres-Simón and Orrego-Carmona (2015) conduct an eye-tracking study to examine the effect of translation strategies in manga reading, using popular Japanese manga translated into Spanish. They compare materials that are translated using either foreignising or domesticating strategies (Venuti 1995)[11] to test whether the decision to use a certain translation strategy would affect the readers' cognitive load and reading behaviour. Their findings show that the domesticating strategies seem to demand more attention for processing the text while the foreignising strategies seem to demand more attention for processing the images as well as more complex reading patterns than domesticating strategies. Their findings also indicate

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[10] There are a few studies that take an experimental approach to onomatopoeia. For example, Laing (2015, 2017) conducts an eye-tracking study to examine infants' perception of onomatopoeia. However, to the best of our knowledge, there have been very few studies on onomatopoeia in manga.

[11] Foreignizing translation strategy generally refers to an approach where specific cultural aspects are retained in the target text whereby the target text might even deviate from the cultural norm of the target text. Domestication, in contrast, is a strategy which generally aims to minimise the foreignness. See Venuti (1995) for a fuller discussion.

that foreignising demands further processing for comprehension. They also report that the degree of familiarity with Japanese culture negatively impacts on reading patterns for domesticating strategies. Most of their participants read manga weekly and are familiar with Japanese culture. In this context, they argue that domesticating strategies could lead to a certain confusion in reading, attributing such confusion to the disconnection amongst the elements in manga in domesticating strategies. According to Torres-Simón and Orrego-Carmona (2015: 386–387), '[w]hile the meaning might be understood, certain items seem out of place in manga where characters behave Japanese, but do not eat Japanese. The reader takes longer to connect the word to the context implying a longer fixation in the text.' Their questionnaire findings also show a high degree of acceptance of foreignising strategies (Torres-Simón and Orrego-Carmona, 2015).

As we have shown, these studies shed some light on manga reading behaviour in general using eye-tracking technology. Similarly, as we have shown in 2.1, there has been a substantial body of research in onomatopoeia in manga that attempt to explore the contributions onomatopoeia in manga makes for communication. However, to the best of our knowledge, there have been few empirical studies that focused on onomatopoeia in manga or the theoretically grounded study that is empirically supported. If onomatopoeia in manga is indeed such an important and integral part of manga, it is useful to gain further insight into its role in readers' experience of reading manga. In particular, little attention has been given to translation strategies for onomatopoeia in manga from an empirical perspective. This would also have implication for Pragmatics, as translation strategies commonly employed in current practice appear to involve what is explained as the *showing-meaning* continuum as discussed in Relevance theory. To address this gap in research, we conducted eye-tracking experiments. In the next section, we will present a description of our data collection methods.

## 3. Research design: eye-tracking experiment

As discussed in 2.1, our research questions are:

(1) Do different translation strategies for onomatopoeia demand different levels of attention and cognitive load?
(2) If so, how could a theory of pragmatics help explain why such differences arise?

To answer these questions, we conducted eye-tracking experiments to elicit objective reading behaviour to establish optimal translation strategies. We chose to conduct eye-tracking experiments as it would allow us to gain insight into readers' engagement with the materials by measuring visual attention[12] (c.f. Just and Carpenter, 1980; Hoffman, 1998; Holsanova, 2011).

Participants were all self-designated manga fans, recruited through university societies as well as through specialist comic shops in Dublin. This would remove the issue of unfamiliarity with the media. The eye-tracking experiments took place at Dublin City University (Ireland), with the ethical approval from DCU's Research Ethics Committee.

### 3.1. Participants

A total of 12 participants[13] (N = 12; male = 7, female = 5; 17 or under = 1 (8.3%), 18–20 = 4 (33.3%), 21–29 = 6 (50%), and 30–39 = 1 (8.3%)) participated. All participants were familiar with reading manga and had no difficulties with reading directions and reading manga on a digital format.

### 3.2. Eye-tracking experiment settings

The Tobii X2-60 60Hz binocular portable eye-tracking system was used for the experiment. The stimuli were displayed as digital manga chapters in PDF. The same room was used for all experiments.

### 3.3. Stimuli

We chose two chapters[14] (Chapters 32 and 33) from the popular One Punch Man manga series (ONE & Murata, 2009-ongoing) for eye-tracking sessions, as it represents the typical features of the *shonen* genre where onomatopoeia is prevalent. Chapter 32 is 33 pages long while Chapter 33 is 31 pages long, with each page containing at least one onomatopoeia. Participants were asked to read all pages. These chapters were chosen not only for the use of onomatopoeia but also for their suitability to test reception in terms of the storyline and cohesion as a narrative.

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[12] This is well known as the eye-mind hypothesis (Just and Carpenter, 1980:331) which assumes that '[T]here is no appreciable lag between what is being fixated and what is being processed.'

[13] This study unfortunately has a relatively small number of participants. However, according to Zhang and Liu (2017), 5–15 subjects per test stimulus is generally considered the rule of thumb in an eye-tracking study.

[14] As Pagan (2018) explains, in Japan, typically each chapter of Japanese manga is published on a weekly or monthly basis as part of manga magazines such as *Shonen Jump* which contains a variety of manga titles (and hence chapters) from different artists. If a series proves popular enough, then its chapters are published as a collected volume (locally known as *tankōbon*) Each collected volume has several chapters. An episode (or a standalone storyline) might be covered in several chapters, just like any drama series.

Stimuli were presented with two translation strategies: annotation with the Japanese original (AJO), and Full Text Substitution (FTS).[15] As explained earlier, in the first strategy (AJO), the onomatopoeia in Japanese is presented together with a small annotation in a very close proximity to the readers in a way that the *showing* and *meaning* aspects are separated from each other, as the participants cannot read Japanese writing and hence, whatever is presented to them in the Japanese original would only be processed as an image. In the second strategy (FTS), the onomatopoeia is presented in an aesthetically integral manner, in an equivalent expression in English where the *showing* and *meaning* elements are integrated aesthetically as one input (see Fig. 1). The English expressions used in FTS are often onomatopoeic themselves, although they may not be lexicalised enough to be in the dictionary.[16] Each chapter was shown page by page on a computer screen, as shown in Figs. 1 and 2 above.

The experiment was a within-subject design where each participant was exposed to two different translation strategies. One chapter was given in FTS and the second chapter was given in AJO. The participants were divided into two groups. The first group read the first chapter in FTS and the second chapter in AJO. The second group started with the AJO, and then read the second chapter in FTS. The two different translation strategies were presented in alternating order to reduce order effects and to ensure that an element of randomisation was included in the experiment design.

## 4. Findings

### 4.1. Findings from eye-tracking sessions

Mean Participant's Gaze Accuracy for the experiments was 93.3%. To gain insight into participants' interaction with onomatopoeia, onomatopoeia on each page was selected as an Area of Interest (AOI) in the form in which they appear: FTS (Fig. 3), AJO (Fig. 4).



**Fig. 3.** Examples of AOIs (FTS). *One-Punch Man*, page 135, Chapter 33, vol. 6 (VIZ Media Shonen Jump Graphic Novel edition). ONE-PUNCH MAN © 2012 by ONE, Yusuke Murata/SHUEISHA Inc.

[15] Though we identify 'non-translation' as a third strategy above, the researchers did not have access to a Japanese only version, with no annotation. Therefore, this version is not included in the analysis.

[16] See Sell and Pasfield-Neofitou (2015) for the list of common translation of onomatopoeic expressions.

**Fig. 4.** Examples of AOIs (AJO), *One-Punch Man*, page 14, Chapter 32 (VIZ Media Shonen Jump digital vault edition). ONE-PUNCH MAN © 2012 by ONE, Yusuke Murata/SHUEISHA Inc.

We included the fixation and visit to the Japanese original in our analysis, as annotations are displayed extremely closely to the Japanese original, sometimes even *within* its overall shape. Not analysing annotation and Japanese original together would not be a true reflection of the way readers engage in the particular part of the manga page with onomatopoeia. It might not be 'reading' behaviour in the strictest sense, but still the data provides an insight into how readers engage with the onomatopoeia on the manga page. Still, we defined AOIs for the strategy of AJO separately rather than treating them as combined AOIs of annotation and the Japanese original. This was particularly relevant as the onomatopoeia in this strategy is presented to the readers in a way that the *showing* and *meaning* aspects are separated from each other in annotation with the Japanese original. As such, separating AOIs for AJO would enable us to gain insight into the manner in which participants engage with the *showing* and *meaning* aspects. For each AOI, we considered the visit count to measure the level of attention and hence interest (Tullis and Albert, 2013; Kim et al., 2012; Tobii, 2020) and the fixation count for the cognitive load. Both measures are used in eye tracking studies for a variety of purposes. (see, e.g., Rayner, 1978; Johnson et al., 1989; Pan et al., 2004; Poole and Ball 2005; Marshall, 2007; Kim et al., 2012).

A fixation is generally defined as 'a period of time when the focus of the participant's gaze is relatively still on an area and taking in information about that which is looked at' while a visit is defined as the period of time when a participant first focuses on a region until the person looks away from that region (Tobii Technology, 2020). A visit, therefore, necessarily involves at least one fixation but could involve more than one fixation and saccades[17] between fixations.

A fixation is commonly used as a measure for the cognitive load which reflects 'the task difficulty and information complexity' (Rayner, 1978; Johnson et al., 1989; Pan et al., 2004; Marshall, 2007; Kim et al., 2012). As such, if something requires a longer fixation, it is seen as cognitively more demanding and hence is said to indicate the difficulty. In contrast, a visit counts aggregated fixations and saccades to an AOI and is considered to be the indication of the level of interest (Tullis and Albert, 2013).

Both fixations and visits are often measured by the length of time spent (duration) and the number of times they occurred (counts). While both measures are commonly used across the eye tracking literature, durations might not be the most reliable measure for this study. Prassee (2011:11) points out the limit with the fixation duration in that Tobii software does not allow zero-fixation to be included in the data and hence, even if there are participants who do not fixate on a certain AOI, the lack of fixation cannot be reflected in the analysis. Similarly, visit durations can be impacted by the number of fixations, which are considered as an indication of cognitive load, contained in a visit. So, an increased visit duration might be an indication of the

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[17] Saccade is defined as 'rapid eye movements designed to shift the fovea to objects of visual interest' (Termsarasab et al., 2015).

high number of items to process (Prassee, 2011, 5) rather than the result of increased interest. In the context of this study where the size of AOIs differs radically between FTS/AJO, durations will not work as an appropriate measure. As such, we focus on the visit count and fixation count[18] in our analysis.[19]

First, we ran an ANOVA test to establish whether the difference between strategies is statistically significant. The result shows that the differences in terms of Visit Count and Fixation Count across the three AOIs (and hence two translation strategies) are statistically significant, as the $f$ value is larger than the $f$ critical value ($f = 49.58$, $f$ crit $= 3.15$ in Visit Count, $f = 31.03$, $f$ crit $= 3.15$ in Fixation Count).

Table 1 shows the mean visit counts across two translation strategies with the data from three types of AOIs:

**Table 1**
Mean and standard deviation for visit count.

| Translation strategy | Strategy 1: Annotation with the Japanese Original (AJO) | | Strategy 2: Full Textual Substitution (FTS) |
|---|---|---|---|
| Areas of interest | ANNO | JP | FTS |
| Mean | 3.39 | 13.67 | 47.35 |
| Standard deviation | 2.23 | 8.84 | 23.03 |

Our findings given in Table 1 show that FTS has the highest visit count, indicating that FTS attracted more interest than the other two AOIs (or is the area of most importance), followed by the Japanese original. Annotation attracted the least interest of the three AOIs. Furthermore, when we compare two strategies, FTS still attracts a much higher number of visits than the other strategy.

Next, Table 2 shows the mean fixation count across the translation strategies:

**Table 2**
Mean and standard deviation for fixation count.

| Translation strategy | Strategy 1: Annotation with the Japanese Original (AJO) | | Strategy 2: Full Textual Substitution (FTS) |
|---|---|---|---|
| Areas of interest | ANNO | JP | FTS |
| Mean | 3.67 | 19.67 | 73.65 |
| Standard deviation | 2.68 | 21.04 | 45.32 |

This shows that FTS again has the highest number of fixations, followed by the Japanese original while annotations have least fixation counts. Again, when we compare strategies, FTS still had a higher number of fixations than AJO. This suggests that FTS is the most demanding strategy in terms of cognitive load.

## 5. Discussion: eyes, onomatopoeia and relevance

Our findings on the visit count presented above show that the FTS translation strategy attracted most interest compared with the other strategy. FTS also attracted the most fixation counts. In contrast, annotation attracted much fewer fixation counts and visit counts. At the strategy level, FTS also attracts more fixation counts and visit counts compared with AJO. Coming back to our first research question, this implies that the FTS strategy demands a higher level of attention and cognitive processing, when compared with the strategy of annotation. The question is, what do these findings tell us and what would be the implication of these findings for Relevance theoretic analysis of onomatopoeia?

As we saw earlier, Sasamoto and Jackson (2016), Rohan et al. (2018), Sasamoto (2019) argue that onomatopoeia involves both *showing* and *meaning* aspects, contributing to communication by providing both direct evidence (via the perceptual resemblance between its phonological form and the source experience) and indirect evidence (via its coded content), while onomatopoeia in manga carries further *showing* elements via its aesthetic presentation. The *showing* aspect of onomatopoeia, which provides direct evidence for communication, brings about impressions that perceptually resemble the source experience. The further *showing* aspect of onomatopoeia in manga would also provide direct evidence for communication, contributing to the sharing of impression (or dynamics or atmosphere, as discussed in previous studies). This means that FTS

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[18] There is also a limit to fixation counts as a measure, as they reflect the number of items that need processing (Polle and Ball, 2005) and frequent fixations could simply mean that a particular AOI, especially if it is a text, involves more words to process (Prassee, 2011). However, it is not necessarily an issue for the current study as our focus is not on a long text, but on a single word.

[19] Furthermore, the ANOVA test results show that differences amongst the two translation strategies are statistically significant for fixation count and visit count, but not in fixation duration and visit duration, further supporting our selection of measures.

carries both *showing* and *meaning* aspects (or direct and indirect evidence for communication) as a lexical item *as well as* the further *showing* element (or direct evidence) through its aesthetic features, whereas the Japanese original would only have the *showing* aspect as an image, as participants do not process it as a linguistic expression and hence the indirect evidence that could have been provided through the *meaning* aspect is left unprocessed. Annotation, in contrast, provides the direct and indirect evidence as an onomatopoeic expression only and does not carry a further *showing* element as part of aesthetics in the same way as FTS or the Japanese original do.[20]

The fact that FTS, which is embedded in the aesthetics of manga while carrying the lexical features of onomatopoeia, has a statistically significant higher fixation and visit count than the other strategy, the combination of annotation with the Japanese original (AJO), suggests that the presentation of *showing* and *meaning* as separate entities as we can see in the combination of annotation and the Japanese original might not engage the readers as well as onomatopoeia that is designed and presented as a single communicative unit like FTS. This is particularly evident in annotation, which seems to attract little interest from the participants. This might be linked to its lack of *the showing* aspect compared with the other two AOIs. That is, the *meaning* element, which is displayed with limited aesthetic features, does not seem to attract participants' attention in the environment where multiple inputs, such as images and onomatopoeia, are orchestrated as part of aesthetics and presented together with written dialogue as a manga page.

This leaves the question of the Japanese original - despite its lack of the *meaning* aspect, the Japanese original still attracts some interest from the participants. So, why would the Japanese original still attract some interest when annotation, which also lacks one aspect of meaning, attracts very little attention? This could be linked to the types of assumptions the readers could recover via direct evidence provided by Japanese original onomatopoeia presented as an image. While the meaning of annotation is fairly determinate and does not encourage readers to pursue inference beyond recovering the concept encoded by the annotated word, the range of assumptions one could recover from an image is indeterminate, leading readers to entertain impressions the manga artists (seemingly) intend to share.[21] This could explain why readers engage more with the Japanese original than with the annotation.

The fact that FTS attracts the most visits suggests that participants interact with manga-onomatopoeia presented as a whole, leading to increased interest, as opposed to onomatopoeia presented separately as an image and a lexical item. As repeatedly mentioned, FTS is the combination of the linguistic translation of the onomatopoeia with the aesthetic presentation of the expression embedded in the manga page. That is, the meaning of FTS, which consists of impressions that are delivered through the *showing* element of the image in addition to the *showing* and *meaning* element delivered through the lexical aspect, make it a higher perceptual priority/interest to participants than the other strategy that separate the *showing* and *meaning* elements.

In addition to these results, what is interesting from the perspective of Relevance Theory is the nature of visual stimuli and its abstractness/indeterminateness. Our findings show that even when there is an annotation that provides linguistic input for onomatopoeia, readers still visit the Japanese original. For readers who do not read Japanese, such onomatopoeia (the Japanese original) would deliver the *showing* aspect (or direct evidence) only, and the direct evidence does not even give a concrete representation. That is, onomatopoeia in manga is extremely abstract and its meaning is extremely indeterminate for one who does not understand the language. Unlike portrait or landscape painting, where one can 'interpret' what is depicted to some degree, onomatopoeia in manga, to an untrained/illiterate eye, would be just lines and shapes. Their interpretation would be very vague and recovering any concrete interpretation would be challenging. However, the aesthetics of such onomatopoeia, even if it does not 'make sense' as a code, still attracts readers' attention. They cannot read it as language, they cannot interpret it as an image. But they still engage with these AOIs. Why is that? The Relevance Theoretic notion of weak communication and determinate-indeterminate continuum (Sperber and Wilson, 1986/1995, 2015) could help us account for such behaviour.

In Relevance Theory, it is acknowledged that communication is a matter of degree, and the speaker's meaning could range from determinate to indeterminate (Sperber and Wilson, 2015). A communicator might produce an utterance that leads to the recovery of a single, strongly evidenced proposition on the one hand. On the other hand, a communicative stimuli might convey poetic effects or a broader range of extremely weakly communicated assumptions, which might not even be propositional (see Blakemore, 2008; Pilkington, 2000; Sperber and Wilson, 1986/1995, 2015; Wharton, 2009 for a fuller discussion). In the case of manga, even if the onomatopoeia does not 'make sense', it could still help give rise to extremely weak, non-propositional effects. That is, readers still attend to onomatopoeia in the original Japanese as ostensively delivered stimuli. Lines and shapes would correspond to the atmosphere the manga artist intends to depict. Lines and shapes, just like font and typeface that a writer can use to guide readers' interpretation process (see Scott and Jackson, 2020), could lead readers to recover non-propositional effects that would be suitable in that particular context. This way, Relevance Theory enables us to account for how indeterminate non-coded stimuli could be interpreted, and our eye-tracking data provides some empirical support for it.

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[20] Also, it is generally agreed that the replacement of onomatopoeia with an expression in English often results in the loss of intangible meaning (c.f. Flyxe, 2002; Inose, 2008; Bartashova and Sichinskiy, 2014), which might mean that the *showing* element carried by the use of annotation has further limitations.

[21] See Sperber and Wilson (2015) for a fuller discussion on impressions and determinate/indeterminate meanings.

## 6. Conclusion

This study set out to gain theoretically founded, empirically supported insight into the way different translation strategies of onomatopoeia influence readers' interactions with onomatopoeia in manga. To this end, we conducted an eye-tracking experiment and analysed the findings from the perspective of Relevance Theory, applying the notion of the *showing-meaning* continuum in particular. Our findings show that FTS, which has the full *showing* and *meaning* aspect as onomatopoeia in manga, attracts most interest and is the area that receives most attention, when compared with annotation or the Japanese original. This suggests that separating the *showing* and *meaning* elements could result in a loss of engagement potential with readers, and FTS would be the recommended translation strategy of for the best level of attention.

This study also showed how empirical research methods such as eye-tracking could be used to provide supporting evidence for a theoretically founded explanation of how linguistic forms contribute to communication. Albeit in a limited manner (and a small-scale sample), this study could pave the way for a new approach in Relevance Theory, as it is the first attempt at a theoretically grounded discussion with empirical evidence-based analysis of how readers engage and interact with onomatopoeia in manga. Further research would be necessary to determine the level of *showing*-ness, for example, and how it influences the readers' response.

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## Declaration of competing interest

There is no conflict of interest.

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**Olivia Rohan** is a former PhD student at the School of Applied Language and Intercultural Studies (SALIS), Dublin City University. Her research interests include onomatopoeia and manga.

**Ryoko Sasamoto** is Associate Professor at the School of Applied Language and Intercultural Studies (SALIS), Dublin City University. Her research expertise is in the interdisciplinary area, working across different disciplines such as Relevance Theoretic Pragmatics, Audiovisual Translation, Reception Studies, and Linguistics. She is particularly interested in communication beyond verbal meaning, onomatopoeia, and multimodal interaction with a focus on telop.

**Sharon O'Brien** is a Professor in Translation Studies in the School of Applied Language and Intercultural Studies, Dublin City University. She is Associate Dean for Research in the Faculty of Humanities and Social Science at DCU and was the Principal Investigator and Coordinator for a H2020 EU-funded RISE project called INTERACT - The International Network in Crisis Translation. She has also been a funded investigator (Science Foundation Ireland) in the ADAPT research centre for over 10 years. Her research interests include translator–computer interaction, localisation, cognitive ergonomics in translation, translation quality assessment and translation in crisis scenarios.