

# Popularizing science – Analyzing the presenter’s multimodal orchestration in a TED Talk

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## Abstract

In today’s neoliberal economy, digital platforms have led to a proliferation in science popularization where scientists package their messages for the wider public. Our study explores how science ideas are disseminated in one of the most widespread digitally-mediated genres of science popularization, the TED talks. We adopt a multimodal discourse analysis approach to explore how the presenter orchestrates her speech, visuals on slides, and hand gestures to achieve the communicative purposes of the TED talk. From the analysis, it is observed that the presenter uses many specific linguistic choices to clarify the ideas and build the speaker’s authority. These language choices are supported by visual choices and gestures. We analyze the presenter’s multimodal semiotic choices and examine how they work together to communicate scientific ideas to the layman and engage with the audience. Our study reveals a deeper understanding on the power of language, visuals, and gestures as communicative tools in presentations, and sheds light on how the three modes are orchestrated to present scientific ideas in an accessible and engaging manner as part of science popularization.

**Keywords:** multimodal discourse analysis, TED talks, speech, visuals, gestures

## Resumen

*Popularizando la ciencia –Analizando la orquestación multimodal en un discurso TED*

En la economía neoliberal actual, las plataformas digitales han dado lugar a una proliferación de vídeos de divulgación científica en los que los científicos

adaptan sus mensajes para el gran público. Nuestro estudio explora cómo se difunden las ideas científicas en uno de los géneros de divulgación más extendidos por medios digitales: las charlas TED. Adoptamos un enfoque de análisis del discurso multimodal para explorar cómo la presentadora orquesta su discurso, los elementos visuales de las diapositivas y los gestos de las manos para lograr los propósitos comunicativos de la charla TED. A partir de este análisis se observa que la presentadora utiliza muchos recursos lingüísticos para aclarar las ideas y construir la autoridad del orador. Estos recursos lingüísticos se apoyan en opciones visuales y gestos. Desgranamos las opciones semióticas multimodales de la presentadora y examinamos cómo se combinan para comunicar ideas científicas una audiencia no especializada y atraer su atención. Nuestro estudio revela una comprensión más profunda del papel del lenguaje, los elementos visuales y los gestos como herramientas comunicativas en las presentaciones y arroja luz acerca del modo en que se orquestan estas tres modalidades para presentar las ideas científicas de forma accesible y atractiva como parte de la divulgación científica.

**Palabras clave:** análisis del discurso multimodal, discurso TED, discurso, elementos visuales, gestos

## 1. TED talks as science popularization

In today's neoliberal economy, scientists are increasingly incentivized to reach out to the layman to communicate scientific ideas in accessible and engaging ways to gain attention and seek financial support for their research (Rödder, 2009; Pérez-Llantada, 2021). Responding to the new social exigencies, such as reaching out to a broad audience, the use of digital platforms is gaining momentum in science popularization and has led to various digitally-mediated genres, like online science news, research group blogs, "60-second science" podcasts, and TED talks (Luzon, 2017; Mattiello, 2017; Ye, 2021; Zhang, 2018). These genres have attracted increasing scholarly interest, with extant research on these emerging genres ranging from generic features, such as move structure and lexical-grammatical strategies to the use of multimodal resources like hyperlinks and images in communicating science ideas (Harrison, 2021; Luzon, 2017, 2019; Mattiello, 2017; Pérez-Llantada, 2021; Ye, 2021; Zhang, 2018). Analyzing how scientific knowledge is popularized in digitally mediated genres can deepen our understanding of digital science communication, inform scientists and researchers of the ways to use various resources afforded by digital platforms, and reveal the influence of neoliberal ideology on science

discourse. Towards these ends, our study examines how science ideas are disseminated in accessible and engaging ways for the layman in one of the most widespread digitally mediated genres, the TED talks.

TED (Technology, Entertainment, Design) is a non-profit organization aiming to spread the latest technology and discoveries to the public (<<http://www.ted.com/about/our-organization>>). The proliferation and popularity of TED talks have attracted much research interest, such as the application in teaching and learning, and the use of structural and linguistic features (D'Avanzo, 2015; Jiang, 2017; Scotto di Carlo, 2015a, 2015b; Takaesu, 2013). In TED talks, presenters not only use language but also other semiotic modes like visuals and gestures to communicate ideas to the lay audience (Rasulo, 2015). Our study adopts the Systemic Functional Multimodal Discourse Analysis (SF-MDA) Approach (O'Halloran, 2004, 2008; O'Halloran & Lim, 2014) to investigate the presenter's choices in speech, visuals, and hand gestures in the delivery of the talk, and consider the roles these modes to serve the communicative purposes of the presentation. Specifically, we perform a fine-grained analysis of the intersemiotic choices in the video clip of a popular TED talk "Your body language may shape who you are" as an illustrative example of the multimodal orchestration in TED talks. We first analyze the unique contribution to meaning each mode brings to the multimodal discourse in recognition of the functional specialization (Kress, 2010) it serves. We then discuss the emergent meanings (Lim, 2004) arising from the orchestration of the modes in the multimodal ensemble (Jewitt et al., 2016). Specifically, we examine the interplay of meanings across the three modes and analyze the nature of the interrelations in their intersemiosis (Royce, 1998). The SF-MDA approach thus offers a fine-grained analysis of the meanings made by each mode and the multiplication of meanings (Lemke, 1998) that arise from their co-deployment. The findings reported are based on the example talk and should be supported by a larger amount of data in future studies.

A genre refers to a series of communicative events with common purposes agreed by a particular group of people (Swales, 1990, 2004). The aim of a genre is to realize its communicative intention with recognizable expressions within a community. TED talks are video reproduction of the live presentations in TED conferences published on its official website and have also been uploaded on other digital platforms such as YouTube and Facebook. TED talks have been researched as a genre of popular science communication (Lopes et al., 2011; Pan et al., 2015; Ironstone, 2019) given

its focus on disseminating research and communicating scientific ideas to the layman in accessible and engaging ways. To fulfill these communicative purposes, various strategies are used by the presenter to make the content “less abstract, less technical, more familiar” (Mattiello, 2019, p. 61).

The practice of reformulating scientific knowledge for the general audience is broadly defined as science popularization (Bucchi & Trench, 2014; Zhang, 2012). Science is increasingly interwoven with politics, economics, and culture in society (Sinatra et al., 2014). The interest in science popularization is fueled by an increasing desire amongst the public to apply scientific knowledge to understand themselves and their environment and make sound decisions (Dierkes & Von Grote, 2005; Sinatra et al., 2014). Science popularization has become an essential part of the scientific enterprise in the neoliberal economy today.

Neoliberalism has been described as “the deliberate intervention by government to encourage particular types of entrepreneurial, competitive and commercial behavior in its citizens with the market as the regulatory mechanism” (Carter, 2016, p. 33). This is pervasive in every sector of society, including academia and scientific research. From the neoliberalism perspective, science is viewed as a social good and scientific research is to support national economic interests (Carter, 2016; Lorés, 2020). Economic interest influences research priorities as funding bodies are often guided by these agendas. (Krishna, 2014). With this, many scientists respond by promoting their research in ways to highlight the value of their findings and gain social and institutional recognition, with a bid to translate these to governmental funding for their research. Popularization has been seen as a way to promote science to the broader public to gain recognition and strengthen public support for their research (Bucchi & Trench, 2014; Zhang, 2018). In light of this trend, scientists are now positioned as “entrepreneur-scientist” (Ironstone, 2019, p. 159) where they have to compete for resources for their research. Against the backdrop of neoliberalism, science popular genres have become increasingly common and are now a part of the zeitgeist of this age (Zhang, 2018).

Science popularization can take place through different media, such as films, television documentaries, and print newspaper articles. The rise of digital technology has led to a structural change in the popularization of science (Bartling & Friesike, 2014; de Semir, 2010; Puschmann, 2015). Many online platforms, such as online news websites, podcasting applications, and TED

talks, have dramatically extended the potential audience to a global reach (Dunwoody, 2014; Lorés, 2020). TED talks are one of the most popular genres of digital science popularization, and a study on multimodal orchestration can reveal how the presenter’s multimodal choices work in combination to communicate scientific ideas in an accessible and engaging manner.

## 2. The features and forms of TED talks

The scholarly interest in the generic features of TED talks tends to focus on its rhetorical structure (Chang and Huang, 2015; Jiang, 2017) and micro-linguistic features which help to achieve accessibility, engagement, and authority (Compagnone, 2015; Mattiello, 2017, 2019; Scotto di Carlo, 2014a, 2014b). For instance, based on Hyland’s (2010) work on the author-reader relationship in popular science articles, Scotto di Carlo (2014b) studied the use of engagement techniques (evaluative and emotive adjectives, inclusive pronouns) in TED talks, and found those strategies were able to balance the expert and laypeople asymmetry and achieve audience involvement. D’Avanzo (2015) also examined how presenters use hedges and boosters to assert their stances, and reader pronouns and directives to achieve engagement. Mattiello (2017) analyzed TEDsters’ use of narration and maintained that the description of personal anecdotes in TED talks could create a concrete scenario that facilitated the viewers’ understanding as well as enhanced audience engagement through the appeal of emotions. On the other hand, in a comparative study of TED talks and lectures from the MICASE corpus, Compagnone (2016) found that TED presenters endeavored to establish their identity and disciplinary membership so as to underscore their expertise and authority in the knowledge being disseminated.

While earlier studies “have concentrated almost exclusively on the analysis of linguistic features” (Luzón, 2019, p. 168), it is of interest to explore how scientific ideas are communicated through the orchestration of different semiotic modes to serve the goals of the presenter. For example, Rowley-Jolivet (2000, 2002, 2004) has examined the use of visuals in science conference presentations, analyzing the types of visuals used and the roles of the visuals in representing scientific ideas. It is found the visuals are closely correlated with the speech and play an important role in facilitating the audience’s understanding of the ideas. We posit that the presenter’s use

of a range of semiotic modes, such as gestures and slides, can work with the speech to communicate scientific ideas in accessible and engaging ways as well (Mattiello, 2019). Thus far, there have been few studies on the use of multimodal modes in TED talks (Harrison, 2021; Masi, 2016, 2020; Wu & Qu, 2020; Xia & Hafner, 2021). Masi has investigated the presenters' use of hand gestures and found that metaphoric gestures are often used to reinforce the meanings of abstract notions, while deictic gestures are used to enhance audience involvement. In addition, co-speech gestures also function to engage the audience (Masi, 2016). She argues that the hand gestures used in TED talks are a complex multisemiotic system, and further research is needed to account for the interplay of different modes (Masi, 2020).

TED presenters also use slides with visual resources, such as images, tables, graphs, and scripts in their presentations. The visual mode works together with the other semiotic modes (speech and hand gestures) to communicate scientific ideas. For example, using an enactive-ecological approach to embodied communication, Harrison (2021) describes how the synchronization of gesturing (depictions, eye-gaze shifts, posture, and footwork) with the slides helps the audience to make sense of the visuals on the slides and keep their attention. This study shows that the speaker's speech-gesture-slide interplay can contribute to the audience's understanding of the talk. Xia and Hafner (2021) examine how different modes, such as speech, gaze, gestures, visuals, and technologies of shot, can, in their multimodal orchestration, engage the audience. In this study, we first investigate the semiotic choices in speech, visuals, and hand gestures, and then examine how they work intersemiotically in combination across the three modes in TED talks. We posit that a fine-grained analysis of the presenter's choices from a multimodal discourse analysis approach can be productive given the functional specialization (Kress, 2010) and the unique contribution each mode brings to the multimodal discourse. The analysis of the interrelations across the three modes can then reveal the nature of the intersemiosis in the multimodal ensemble and elucidates how the modes work together in their co-deployment to communicate scientific ideas in accessible and engaging ways. Our study is guided by the research question: How does the presenter's use of speech, visuals, and gestures in the TED talk communicate scientific ideas in accessible and engaging ways?

### 3. A multimodal discourse analysis approach

From the multimodal perspective, each semiotic mode has its functional specialization (Kress, 2010) and its “own inherent set of rhetorical devices” (Shannon, 2014, p. 7). In Systemic Functional Theory (SFT), language is a semiotic mode for meaning-making (Halliday, 1994) and works together with other modes “based on the interrelation between them” (Valeiras-Jurado et al., 2018). The Systemic Functional Multimodal Discourse Analysis approach (SF-MDA) (O’Halloran, 2004, 2008; O’Halloran & Lim, 2014), is applied as the theoretical frame for the present study. From the SF-MDA perspective, meanings made in a multimodal discourse are organized according to the ideational, interpersonal, and textual metafunctions, where the semiotic modes serve to represent experience, enact social relations, and organize the discourse, respectively (Halliday, 1994). For language, the ideational meanings are realized by the system of Transitivity, a system for describing the type of action process that the participant does in a clause. Interpersonal meanings are realized by the system of Mood Block, Mood types and Modality. Mood Block comprises the Subject and the Finite (first functional element of a verb group). Subject is the entity that carries out the transaction (exchange of information or goods/ service), and Finite indicates how valid the proposition is. Mood types are associated with the verb forms that are used in exchanging information or goods/service, including declarative, interrogative, indicative, and imperative mood. Modality is used to describe the space between polarity (‘yes’ and ‘no’), relating to probability, usuality, obligation, and inclination. Textual meanings, that is how the discourse is organized, are realized by the system of Theme and Rheme. This system signifies the starting point of a clause. The Theme is the first constituent of a clause, and the remaining part of the clause is recognized as Rheme.

For visuals, ideational meanings are realized by representational structures, for example, narrative and conceptual processes (Kress & van Leeuwen, 2006). These processes are determined by the relationship between the participants and the nature of the actions. Interpersonal meanings, such as “symbolic contact, social distance, power relations, and involvement between viewers and visual participants” (Feng & O’Halloran, 2013, p. 322) are realized by image act, size of frame, angle, and modality. Specifically, symbolic contact is defined by how the participants gaze at viewers; social distance is usually expressed by the shot distance (long, medium or close shot); power relation is represented by vertical camera angles (high, eye-level, or low); and involvement is realized by horizontal camera angles (frontal or

oblique). Textual meaning is typically realized in the composition and layout of the image, and functions to synthesize the other two meanings into integrity via three systems: information value, salience, and framing, which correspond to the following three aspects: the layout and placement (top and bottom, left and right, center and margin), the prominence and importance of the visual elements, and the connection and disconnection between visual components (Kress & van Leeuwen, 2006).

Informed by SFT, Martinec (2000) developed a typology for classifying actions, including Presenting Action, Representing Action, and Indexical Action. Presenting Actions are gestures with no representational meanings, such as scratching or flipping a page. In contrast, Representing Action has a conventional signifying function, which can serve for communicative purposes. Based on the relationship between gestures and language, Lim (2019) identified two sub-categories of Representing Action as Language Correspondent Gestures or Language Independent Gestures. Indexical Action often occurs with verbal utterances and should be interpreted with concurrent speech (Martinec, 2000), and it is also described as Language Dependent Gestures (Lim, 2019). The ideational meanings in Presenting Actions are realized through Transitivity processes, including Material Process, Behavioral Process, State Process, Verbal Process, and Mental Process. The ideational meanings in Representing Actions are described in terms of a taxonomy of Congruent Entities (Participants, Processes or Circumstances) and Metaphorical Concepts. Indexical Actions are described in terms of the meanings of importance, receptivity, and relation. Based on Martin and White's (2005) appraisal system, the interpersonal meanings of gestures are described in terms of attitude (positive, negative, and neutral), engagement (expansion, contraction, neutral, and possibility), and graduation (fast, medium, and slow). Textual meanings in gestures are described in terms of wavelength (size and rhythm) and pointing (directionality and specificity) (Hood, 2011; Lim, 2019).

The presenter's orchestration of speech, visuals, and gestures are examined through intersemiosis, which includes the ways different modes interplay and the interrelations among these modes (Lim, 2021a; Royce, 1998). The meaning ensembles formed in intersemiosis are often described in the categories of *Meaning Convergence and Meaning Divergence* (Lim, 2004; O'Halloran, 2008). The interplay among semiotic modes work together to express congruent meanings through Convergence, or different or even contradictory meanings through Divergence (O'Halloran, 2008).



## 4. Methods

This study is a part of a larger research project which focuses on a multimodal analysis of TED talks. The TED talk video analyzed was taken from the TED official website. All the TED talks have been posted on the official website with frequent updates. The talks are classified by categories such as “topic”, “the most viewed”, and “the latest”. In this study, we analyze the talk titled “Your body language may shape who you are” (<[https://www.ted.com/talks/amy\\_cuddy\\_your\\_body\\_language\\_may\\_shape\\_who\\_you\\_are](https://www.ted.com/talks/amy_cuddy_your_body_language_may_shape_who_you_are)>), delivered by social psychologist Amy Cuddy. The talk discusses how body language changes people’s behavior and, in turn, changes the outcomes of their life. The talk is in “the most viewed” category, a reflection of its popularity and success, and is on the recommendation list on the TED website. The talk is selected for its popularity and also its illustrative potential to demonstrate the presenter’s orchestration of speech, visuals, and gestures to communicate scientific ideas in accessible and engaging ways. The video clip of this talk lasts about 21 minutes with 3591 words. The transcripts are annotated clause by clause, visuals slide by slide, and gestures action by action. We have identified 48 slides and 249 gestures in this TED talk.

The SF-MDA approach involves a “trinocular” perspective in the analysis (Halliday & Matthiessen, 2014, p. 35). From this perspective, the use of language is viewed “from above”, “from round about”, and “from below”, that is, “its systemic environment”, “its meaning”, and “its form” (Halliday, 2009, p. 80). As such, the contextual factors (the purpose, audience, medium, and the social context), the semantic patterns of the three modes, forms of lexical-grammatical instances, and choices of visual resources and hand gestures are identified. Thus, we perform a detailed annotation of the data, with iterative viewing and zooming into featured instances. The analysis is based on the video clip of the TED talk. Clauses of the transcripts and screenshots are extracted from the video clip for fine-grained analysis and detailed description (Erfanian Mohammadi et al., 2019; Lim & O’Halloran, 2012; O’Halloran, 2008; van Nguyen & Gruba, 2019).

The analysis is done in ELAN (See Figure 1). ELAN is a professional software to manually and semi-automatically annotate audio or video texts. The annotation can be time-aligned and offers the convenience to label the semiotic instances based on the annotation frameworks. It is organized on different tiers (layers) and hierarchically interconnected, which allows

exploration of the interrelations of the annotation on each tier (<<https://tla.mpi.nl/tools/tla-tools/elan/elan-description/>>). The functions such as documentation and search can also help in the iterative reading of the data and identifying the characteristics, as well as locating and getting screengrab at an interesting moment.

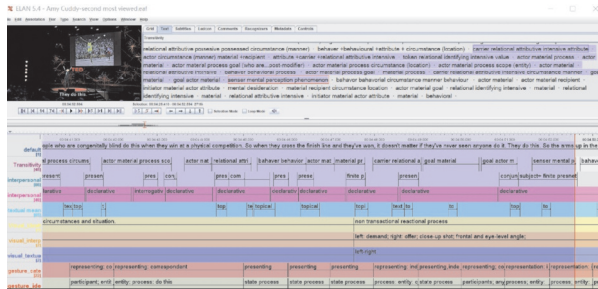


Figure 1 Screenshot from ELAN.

## 5. Findings

### 5.1. Linguistic choices

The analysis of the presenter’s speech is conducted using Systemic Functional Grammar. Ideational meanings are realized through different types of Transitivity processes (Thompson, 2014 [1996]) (see Table 1). We identified 634 clauses and noted that the presenter adopts the Material process most, which accounts for nearly half of the total text. This is followed by the use of the Relational process with a proportion of 23%. Mental process (comprised mainly by cognition and perception) is also chosen at about one-fifth of the total clauses. Verbal process, Behavioral process, and Existential process are less used at the rate of 5%, 3%, and 2% respectively.

Types of Process	No.	Proportion	Examples
Material	310	49%	1 You <b>take up</b> space. 2 ...when they <b>won</b> at a physical competition.
Relational	147	23%	3 What <b>are</b> nonverbal expressions of power and dominance? 4 This <b>is</b> true across the animal kingdom.
Mental	115	18%	5 we don't <b>want</b> to... 6 ...if they've never <b>seen</b> anyone...
Verbal	33	5%	7 We <b>say</b> ("You need to do this or this")
Behavioral	16	3%	8 So, for example, we <b>smile</b> .
Existential	13	2%	9 <b>There's</b> a lot of evidence.
Total	634	100%	

Table 1. Statistics of Ideational Meanings.

Interpersonal meanings are realized through choices in Mood Block, Mood Types, and Modality. The analysis of the Mood Block indicates that most of the 634 clauses have adopted Finite signifying the time present tense. Finite representing past and future only takes 12% (79 clauses) and 2% (12 clauses). The numbers of Mood Types are represented in Table 2. Thus, the Statement (declarative) tops the presenter's choice in Mood types, with small propositions of Question (interrogative) and Command (imperative).

Mood Types	No.	Proportion
Statement (declarative)	543	86%
Question (interrogative)	79	12%
Command (Imperative)	12	2%

Table 2. Statistics of Mood Types.

Moreover, 22 Modal operators have been identified. Most of them are used to modulate the scale of polarity, that is, to explicate the degree of probability of the presenter's opinions and the hypothesis of the research, such as "it could significantly change the way your life unfolds". The analysis of the textual meanings of this talk has also found 478 Themes, with 314 topical Themes, 155 textual Themes, and 9 interpersonal Themes.

From the analysis, it could be seen that the presenter made specific linguistic choices to deliver the talk in accessible and engaging ways. For example, she makes an extensive use of material process (declaratives) with Finite signifying the time present to illustrate abstract concepts, describe the

research process, and report the findings and results. For instance, she introduces a familiar situation of a sports race (“...when they won at a physical competition”), to describe the gestures the winner does when he is crossing the finish line and explains that those gestures (spreading out and arms in the V) are the expressions of pride and power. In this way, the specific action (arms in the V) described in the speech can help the audience make sense of the abstract concept (non-verbal expression of power and dominance). The use of exemplification thus contributes to the clarification of ideas and facilitates the audience’s understanding.

Mental processes of cognition and perception are also used to express the presenter’s opinions and describe the phenomena. The speaker also uses interrogatives with the Relational process as well as uses many textual Themes. For example, questions are often used to elicit the ensuing discussion and textual themes like “so”, “and”, “and also”, “when” are used to signify the logical relation among the clauses. These choices express a logical flow in the ideas, thus strengthening the argumentation and aiding the audience’s understanding of the ideas. The presenter also engages with the audience through speech. For instance, she calls for their actions through the use of commands, arouses their curiosity with questions, and appeals to their emotion or empathy through her personal stories.

On the other hand, the presenter only uses a small proportion of Modal operators, with most of the statements being directly represented. That is, the presenter makes no effort to modulate the statements, but puts forward the meaning in a firm and direct manner to avoid uncertainty. This adds a sense of credibility to what the presenter is saying and helps to reinforce her stance as an authority. Studies have reported that ideas expressed confidently can be effective in persuading the audience (Dafouz-Milne, 2008; Halmari & Virtanen, 2005). The contraction of Modality, in this case, can express a firm and assertive stance, close the space for dialogue, and initiate a higher power status over the audience. This, in turn, can reinforce the speaker’s authority by adding a sense of credibility and persuasiveness to the ideas. This contrasts with the typical use of Modality in academic genres, for example, research articles, which use modal operators to hedge the researchers’ statements and modulate the reporting of findings (Fusari, 2019; Yang et al. 2015).

## 5.2. Visual choices

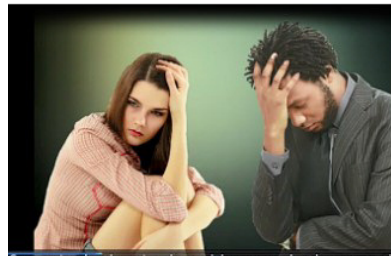
48 slides are presented in the talk, including 18 images, 16 slides of written scripts, 10 bar charts, three flow charts, and one picture of both image and written words. Most of the images depict narrative processes, that is, non-transactional reactional processes. There are also depictions of Analytical processes (bar chart) and Classificational processes (flow chart).

Images are mainly used to exemplify abstract conception, for example, the status of power (Figure 2) and powerlessness (Figure 3). Most of these pictures adopt a left-right composition. Nevertheless, the two participants in each picture are in a parallel relationship rather than “given and new” proposed by the framework (Kress & van Leeuwen, 2006, p. 57). Figure 2 exemplifies this relationship. In this picture, the two participants perform gestures representing expansion. They are placed side by side in equal importance, and there is no clue indicating a comparison between old and new information. Figure 4 is in a foreground and background composition. The participants in each image are the most salient elements.



Note. It appears from 4:18 to 4:25 . The transcripts are “And humans do the same thing. So they do this when they have power sort of chronically and also when they are feeling powerful at the moment”.

Figure 2



Note. It appears from 5:07 to 5:09. The transcripts are “So again, both animals and humans do the same thing”.

Figure 3



Note. It appears from 4:27 to 4:57. The transcripts are “And this one is especially interesting because it really shows us how universal and old these expressions of power are. This expression, which is known as pride, Jessica Tracy has studied. She shows that people who are born with sight and people who are congenitally blind do this when they win at a physical competition. So when they cross the finish line and they’ve won, it doesn’t matter if they’ve never seen anyone do it. They do this. So the arms up in the V, the chin is slightly lifted.” From 4:41 to 4:54, this slide is shown in the background, with the presenter acting out some gestures in the foreground.

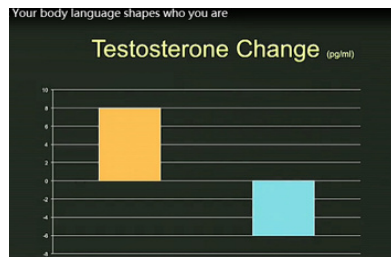
Figure 4

The experiential meanings are realized through participants and representational structures. Most of the main participants in this image series are in non-transactional reactional processes. In Figures 2 and 3, for example, the participants are gazing away with their eyelines functioning as vectors but with no phenomena (the goal of the eyeline) presented in the pictures. As for interpersonal meaning, most of the main participants are presented as “offer” rather than “demand” images (Kress & van Leeuwen, 2006). These images do not invite the viewers into a social relationship with the participants but serve to provide information, directing the viewers’ attention instead to the actions performed by the participants. These images are in a medium from the front and at an eye-level angle, which suggests a professional relationship and equal power status (Kress & van Leeuwen, 2006). Classificational process (flow chart, see Figure 5) and Analytical process (bar chart, see Figure 6) are also adopted to help describe the experiment process and make the results clear. These charts can aid the audience in grasping the key information and contribute to the clarification of the ideas. Similarly, words are also represented visually on the slides (Figure 7) to reinforce key ideas.



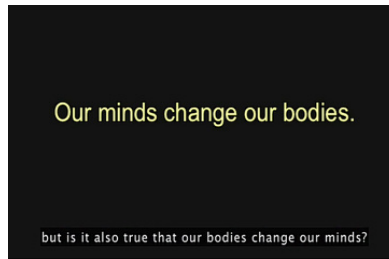
Note. It appears from 11:08 to 11:29. The transcripts are “for two minutes, we say, ‘You need to do this or this. They don’t look at pictures of the poses. We don’t want to prime them with a concept of power. We want them to be feeling power. So two minutes they do this. We then ask them, ‘How powerful do you feel?’ on a series of items, and then we give them an opportunity to gamble and then we take another saliva sample. That’s it. That’s the whole experiment.”

Figure 5



Note. It appears from 11:46 to 12:00 in animation. The transcripts are “Here’s what we find on testosterone. From their baseline when they come in, high-power people experience about a 20-percent increase, and low-power people experience about a 10-percent decrease. So again, two minutes, and you get these changes.”

Figure 6

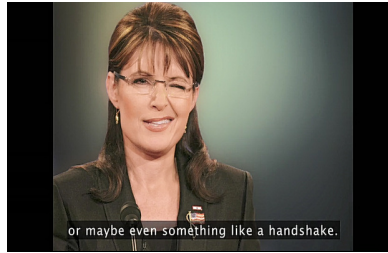


Note. It appears from 8:03 to 8:05 . The transcripts are “So we know our minds change our bodies...” .

Figure 7

Images of specific hand actions (Figures 2 and 3) are displayed to support the meanings made with speech. While explaining the expressions of high power verbally, the representation of participants either spreading their arms up (Figure 2) or holding their hands crossing on the head (Figure 3), can help the audience visualize the instantiated “non-verbal expressions of power and dominance”. For example, Figure 4 exhibits the image of a winner in a running race at the finish line. With the specific winning setting, this image can help the audience to understand that the gesture of a letter “V” signifies victory and pride and is one form of the “power and dominance”. In this way, the use of images reinforces the meanings communicated through spoken language.

The images also promote audience engagement through the interpersonal meaning expressed in the pictures chosen in this talk. According to Kress and van Leeuwen (2006), the direct gaze of the participants, the medium close-up shot, and eye level frontal angle can evoke a sense of intimacy with the viewers (Figure 8). The participants’ actions of winking represented in this image is relatable and implies a shared meaning with the audience. The interpersonal meanings expressed by the medium close-up shot of the images, as well as the frontal eye level angles help to express a sense of involvement. The image serves to heighten the audience’s engagement even without speech.



Note. It appears from 1:18 to 1:22 . The transcripts are “Maybe a very awkward wink or a contemptuous glance, or maybe even something like a handshake”.

Figure 8

### 5.3. Gestural choices

The presenter performs 249 gestures in the talk including 62 Indexical Action, 56 Presenting Actions and 131 Representing Actions. Representing Actions are described in relation to language. From the talk, 34 Language Independent Gestures and 97 Language Correspondent Actions are identified (See Table 3).

Category	No.	Sub-Category	No.
Indexical Actions	62		
Presenting Actions	56		
Representing Actions	131	Language Independent	34
		Language Correspondent	97

Table 3. Types of Gestures.

As can be seen from the data, the presenter deploys many Indexical Actions in this talk. They are usually instantiated into three categories: beatings, open palms, and pointing (Lim, 2019). Beating is manifested in different forms, such as beat downward with index finger (Figure 9) and beat outside with two palms (Figure 10). These actions often function to emphasize the ideational meanings in the correspondent speech. Pointing can be used to engage the audience interpersonally. For example, Figure 11 shows the presenter explaining the research background of the study and saying that “social scientists have spent a lot of time looking at the effects of our body language”. While she says, “our body language”, she points to herself with two palms at the same time. This emphasizes the meaning of “our” which is realized both linguistically and gesturally. The emphasis in the collective



meaning of ‘our’ also expresses a sense of inclusiveness and make the audience feel that they are involved with the presenter.



Note. It appears from 2:00 to 2:02 . The transcripts are “So what is your body language (communicating to me)?”. She performs the pointing when she says “your body language”.

\*The content in the bracket is not said in the episode, but to supplement the utterances at this moment for a better understanding.

Figure 9



Note. It appears from 5:43 to 5:44 . The transcripts are “they get right into the middle of the room”. She beats with her arms and hands when she says “right”.

Figure 10

The most frequently used are Representing Actions. Language independent actions indicate the gestures that carry conventionally recognized meanings in the mainstream cultures, such as hands waving horizontally to signify the meaning “no” or “not” (Lim, 2021a). This category of actions is often used to specify and vivify the meaning. Figure 12 exemplifies the use of Language Independent Representing actions. In this screenshot, the presenter closes the tip of the thumb with the tip of the index finger to form a pinching gesture, which is often recognized as signifying “a little”. This helps the audience visualize the meaning from the action.



Note. It appears from 2:15 to 2:16. The transcripts are “(So social scientists have spent a lot of time looking at the effects) of our body language”. She points to herself when she says “our body language”.

Figure 11



Note. It appears from 2:35 to 2:37 . The transcripts are “when people watch 30-second (soundless clips of real physician-patient interactions)”. She acts out a pinching gesture when she says “when people watch 30-second”.

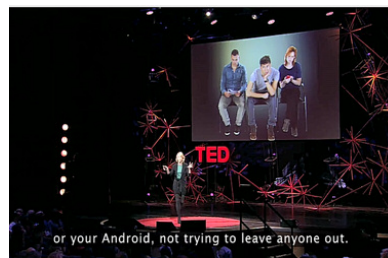
Figure 12

Language Correspondent Representing gestures need to be interpreted with the speech. They are often used to specify, exemplify, or vivify the ideas in the speech, which can help the audience’s comprehension. In Figure 13, when the presenter talks about power nonverbals, she opens up her arms and gives an example of the body language that shows high power. In Figure 14, the presenter draws a semi-circle to signify “anyone”. She raises her two hands and expands her arms as she says, “not trying to leave anyone out”. Her expression of “anyone” in speech is accompanied by the semi-circle she has gesturally drawn in front of her chest with her palms open towards the audience. Her open gestures reinforce the meaning of “anyone” made in speech. The use of gesture and speech thus instantiates a congruent meaning and facilitates her communication of ideas in accessible and engaging ways.



Note. It appears from 5:37 to 5:39. The transcripts are “(MBA students really exhibit the) full range of power nonverbals”. She expands her arms when she says “full range of noneverbals”.

Figure 13



Note. It appears from 13:49 to 13:50. The transcripts are “(You’re looking at your iPhone — or your Android), not trying to leave anyone out”. She beats out with her hands open towards the audience to form a half circle when she says “anyone out”.

Figure 14

Gestures are also used to disambiguate the meanings along with the linguistic choices. The presenter performs gestures to express a dominant or powerless status, such as spreading out (See Figure 15), or wrapping two arms around the shoulder (See Figure 16). These gestures, in themselves, can express meanings of power and timidity. In Figure 15, with fast expanding movement of shoulder, arms and hands together, the presenter spreads her arms up with one fast beat, signifying strength and assertiveness. While in Figure 16, the shrunken shoulder and crossed arms in a medium size and comparatively slow speed suggest a sense of inferiority and depression. These examples suggest that gestures can, to a large extent, allow the audience not only to visualize but also experience the sense of power and dominance.



Note. It appears from 4:10 to 4:12. The transcripts are "(you're basically) opening up. It's about opening up." She keeps this gesture during this period.

Figure 15



Note. It appears from 5:02 to 5:03. The transcripts are "(We) wrap ourselves up".

Figure 16

#### 5.4. Intersemiosis of modes

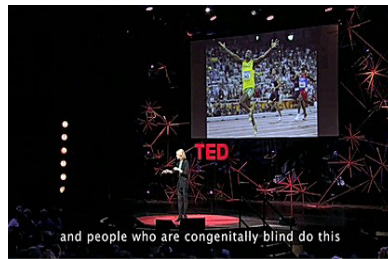
When speech, visuals, and gestures work together, the meanings converge to reinforce the message. For example, in Figure 17, the image displaying on the screen represents a gesture of power and strength where the arms raised in the “V” and chin lifted, while simultaneously, the presenter is acting out the same gesture with a verbal description “the arms up in the V, the chin slightly lifted”. At this moment, the three modes represent the same meaning individually. The meanings are parallel with one another and work together as a whole to achieve meaning reinforcement. In this way, the audience hear, visualize, and experience the abstract concept through the concurrent expressions with the three modes.

The three modes may also supplement one another in meaning. Figure 18 shows such an interplay. The speaker elaborates that “people who are congenitally blind do this” with a gesture of process to signify “do this” by pointing downward with a strong beat. While the two modes are semantically parallel in their expression of the meaning in the action process, it is still not clear what “this” is signifying. The image in the screen at the background supplements the meaning and illustrates the concrete action of “this”. Thus, in this kind of interaction, the visual mode has supplemented the meaning constructed by both verbal and gestural instances and consequently achieve clarity and disambiguation of the meanings. The use of clarification helps to enhance the audience’s comprehension of the key ideas of this talk.



Note. It appears from 4:51 to 4:54. The transcripts are "They do this. So the arms up in the V, the chin is slightly lifted". She raises her arms when she says "They do this." And keeps this gesture when she describes it.

Figure 17



Note. It appears from 4:44 to 4:45. The transcripts are "(people who are congenitally blind) do this". She beats down with index finger when she says "do this".

Figure 18

According to Valeiras-Jurado et al. (2018), the more easily the message is understood, the more persuasive it comes to be. That is, only when the idea is clearly conveyed and easily understood can it be accepted, trusted, and disseminated. Hence, it is of ultimate importance to make the ideas clear in order to persuade the audience. Moreover, as lay persons with diverse backgrounds, it may be difficult for many of the viewers to comprehend the concepts and terminologies in a specific field. Thus, the reference to daily objects, actions, or concrete examples, which are represented by the three modes coherently, could help the audience visualize some of the abstract ideas and enhance their comprehension.

Working with language, gestures can enhance the presenter's credibility when they work in orchestration with language and visuals in this talk. For example, in Figure 19, the speaker says, "that our bodies change our minds and our minds can change our behavior". In the background, the slide with the transcripts of her speech is shown visually, repeating the words in the speech. However, the speaker's gesture of standing with her hands overlapping in front of her body in a relaxed manner, that is, in a State Process, does not express ideational meanings, and instead serve to communicate interpersonal meanings. The relaxed state of hand gesture and the relaxed posture is considered bearing "a positive relationship to that person's perceived dominance and status" (Higdon, 2010, p. 643). Thus, this gesture of state process expresses her dominant and authoritative status, which could make the ideas that are communicated simultaneously by speech and images sound more persuasive (Burgoon & Dunbar, 2006).

The presenter also orchestrates gestures and language to express a sense of involvement, particularly by Indexical Actions (see Figure 11) and Language Correspondent Representing Actions (Figure 20). In Figure 20, the presenter puts the two palms forward while she is saying, “to you” in the utterance “What’s mine communicating to you?”. This gesture, palms opening up towards the audience, is often taken as an invitation for comments or opinions. Working together with speech, the gesture is inviting the audience to engage in the discussion (Hao & Hood, 2019).



Note. It appears from 15:40 to 15:42. The transcripts are “that our bodies change our minds and our minds can change our behavior”. She keeps holding her two hands in front of her body in this period, and moves on the stage in a relaxed manner.

Figure 19



Note. It appears from 2:04 to 2:05. The transcripts are “(What’s mine) communicating to you”. She puts her palms outside towards the audience when she is saying “to you”.

Figure 20

## 6. Discussion

As a genre of online science communication, TED talk’s communicative purposes involve transmission, persuasion, and promotion. Based on our observations from the findings, we seek to answer the research question of how the presenter orchestrates the use of speech, visuals, and gestures to communicate scientific ideas in accessible and engaging ways. It has been observed that the speaker uses the three modes strategically to communicate scientific ideas in accessible and engaging ways. The three modes have been used to instantiate abstract concepts, report the findings and results, and heighten the key messages. The presenter also orchestrates semiotic modes to present a confident and credible persona to the audience.

Against the backdrop of neoliberalism, there is an increasing demand in public engagement in scientific knowledge. The strategic ways of knowledge dissemination in TED talks enable researchers to make their latest scientific findings accessible and engaging to the public. In this way, the TED

presentations help highlight the value of the research to the public (Lorés, 2020). The strategic orchestration of the three modes in TED talks has been observed in other marketing genres, such as television advertisements and corporation sales pitches, which aim to sell products and services (Daly & Davy, 2016; Francesconi, 2017). These ways of meaning representation are also found in other popular science genres, like online science news and social networks (Lorés, 2020; Zhang et al., 2015), revealing the promotional and commercial nature and achieving the aim of communication and “retailing” of science (Zhang, 2018, p. 19).

TED talks are available internationally through online platforms. This ease of access has allowed educators to make use of them as authentic materials in English language teaching practices, particularly in the instruction of oral presentation skills. TED talks have been adopted as model presentations in oral presentation courses and reported to be useful in developing students’ presentation skills, speech organization, development of argumentation, and so forth (Kedrowicz & Taylor, 2016; Li et al., 2016; Salem, 2019). The understandings on the use of speech, visuals, and gestures to disseminate scientific ideas in TED talks in accessible and engaging ways can inform students on how each mode can be used to express specific types of meaning, as well as how the three modes can be orchestrated in a multimodal presentation. The insights drawn from the findings can function as a heuristic tool to inform the development of students’ multimodal presentation skills by offering them a deeper understanding of how successful TED Talk presenters have designed their communication.

Our study has shown that TED presenters make different semiotic selections to communicate scientific ideas in accessible and engaging ways. One of the ways that have been observed in the talk we analyzed is how ideational meanings can be reinforced across speech, visuals, and gestures. The convergence of meanings contributes to achieving clarity in the communication, especially, in helping to vivify the ideas in speech and facilitating the audience visualization of abstract concepts expressed in speech. A pedagogical implication is for students to be aware of how their message can be reinforced through their intentional choices in speech, visuals, and gestures in their multimodal presentation. Specifically, such reinforcement can be expressed through using the three modes to express the same meanings or having them supplement one another in meaning. For example, the use of visuals or gestures can exemplify or vivify a reference made in speech to achieve clarity and disambiguation of meanings.

Our study has also found that the interpersonal meanings made across the three modes, could, at certain moments, seem opposing to each other, but would overall serve the communicative function of both expressing the presenter's authority and power yet maintaining an inviting and open posture in her engagement with the audience. For example, the use of a small proportion of modality to modulate statements in speech and the choice of a relaxed posture can enhance the sense of authority of the presenter, even when the choices in visuals are intended to evoke a sense of rapport and connection between the presenter and the audience. As such, another pedagogical implication for students to consider is how the emergent meanings can be expressed with specific choices in speech, visuals, and gestures. Such orchestration of modes can achieve a “structured informality” (Lim, 2021b) where the interplay of meanings serves at once to signal the presenter's expertise and authority yet also create a sense of solidarity and rapport with the audience. Such emergent meanings of structured informality are arguably important, given that the TED presenters need to position themselves and their ideas authoritatively so as to appear credible to the audience yet present themselves as relatable and even likeable by the lay audience in their bid to engage, and even entertain, them. The orchestration of the modes to express “structured informality” is possibly a distinctive feature of the science popularization genre, although this conjecture has to be investigated in further research.

Our study has demonstrated how a SF-MDA approach can be applied to investigate the ways presenters communicate scientific ideas in TED talks. The exploration of the contributions made by the individual modes of speech, visuals, and gesture, as well as how the three modes work together in orchestration address the paucity of studies on the interplay of more than two semiotic modes in multimodal research. The findings in this study also deepen our understanding on the power of speech, visuals, and gestures as communicative tools in presentations and how the three modes are orchestrated in popularizing scientific ideas. While the present analysis is only based on one popular TED talk, the insights from the analysis can point to further studies on the speech-visual-gestural intersemiosis. Future research can also be conducted from an ethnomethodological perspective, such as interview with the viewers and an analysis on the audience's comments on the website, which can triangulate the interpretation of the findings from the study.

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