Data Article

CineScale: A dataset of cinematic shot scale in movies

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ABSTRACT

We provide a database containing shot scale annotations (i.e., the apparent distance of the camera from the subject of a filmed scene) for more than 792,000 image frames. Frames belong to 124 full movies from the entire filmographies by 6 important directors: Martin Scorsese, Jean-Luc Godard, Béla Tarr, Federico Fellini, Michelangelo Antonioni, and Ingmar Bergman. Each frame, extracted from videos at 1 frame per second, is annotated on the following scale categories: Extreme Close Up (ECU), Close Up (CU), Medium Close Up (MCU), Medium Shot (MS), Medium Long Shot (MLS), Long Shot (LS), Extreme Long Shot (ELS), Foreground Shot (FS), and Insert Shots (IS). Two independent coders annotated all frames from the 124 movies, whilst a third one checked their coding and made decisions in cases of disagreement. The CineScale database enables AI-driven interpretation of shot scale data and opens to a large set of research activities related to the automatic visual analysis of cinematic material, such as the automatic recognition of the director's style, or the unfolding of the relationship between shot scale and the viewers' emotional experience. To these purposes, we also provide the model and the code for building a Convolutional Neural Network (CNN) architecture for automated shot scale recognition. All this material is provided through the project website, where video frames can also be requested to authors, for research purposes under fair use.

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Specifications Table

Subject	Arts (General), Film studies, Video content analysis
Specific subject area	Quantitative analysis of shot scale in films
Type of data	Table (.CSV format)
How data were acquired	Shot scale annotations were provided by three human coders (2 coders + 1 who made decision in case of disagreement) in tabular form.
Data format	Raw
Parameters for data collection	Annotated frames were extracted at 1 frame per second (fps)
Description of data collection	The database contains the shot scale annotations for about 792,000 frames from 124 full movies from the entire filmographies by 6 authors: Martin Scorsese, Jean-Luc Godard, Béla Tarr, Federico Fellini, Michelangelo Antonioni, and Ingmar Bergman.
Data source location	Institution: University of Brescia City/Town/Region: Brescia Country: Italy Latitude: 45.564664 Longitude: 10.231660
Data accessibility	Repository name: Mendeley Data Data identification number: doi:10.17632/th46h4vdwd.1 Direct URL to data: https://doi.org/10.17632/th46h4vdwd.1 Project website: https://cinescale.github.io

Value of the Data

- The data can be used by both computer scientists and film scholars to perform quantitative analysis of shot scale in movies.
- The data are useful to develop models and classification strategies to automatically predict the shot scale in movies.
- The actual dimensions of this dataset are of unprecedented size, more than 15 times bigger than those published so far.
- There are evidences that the statistical distribution and the temporal pattern of some frequent cinematic features, such as shot scale, might act as a stylistic fingerprint of a specific director.
- By evaluating the statistics of such cinematographic feature, it is possible to investigate of how shot scale influences the film viewing experience in viewers, such as empathy-related processes.

1. Data Description

Data consists of shot scale annotation for about 792,000 frames on the following 9 shot scale classes: Extreme Close Up (ECU), Close Up (CU), Medium Close Up (MCU), Medium Shot (MS), Medium Long Shot (MLS), Long Shot (LS), Extreme Long Shot (ELS), Foreground Shot (FS), and Insert Shots (IS).

1.1. Shot scale

Shot scale measures the relative distance of the camera from the main filmed object, and as such, it is tied to the size of the human figures on the screen and the relative ratio of the foreground to the background [1].
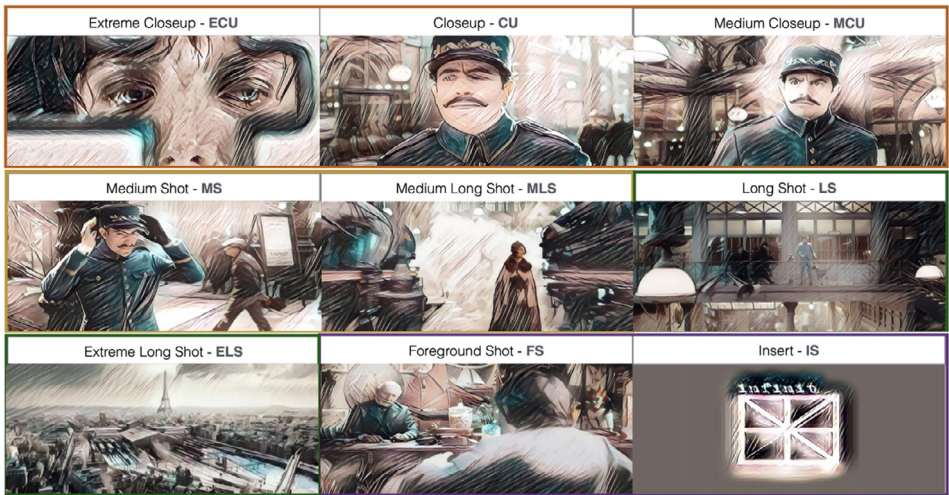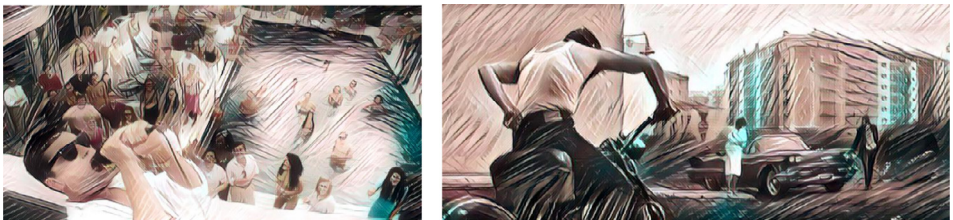
Fig. 1. Shot scale categories considered in this work. Adapted from "Hugo Cabret", Scorsese by [19].

(a) "The wolf of Wallstreet", Scorsese.   (b) "La dolce vita", Fellini.

Fig. 2. Examples of Foreground Shots, adapted by [19].

As such, shot scale is one of the most important cinematic features of any filmic product. The importance of shot scale lies in the fact that, among cinematic techniques which are relevant to viewers' responses [2], it affects both low- and high-complexity responses in viewers, with a strong potential to influence how fictional narratives are processed and experienced [3–5]. Recent findings indicate that the shot scale impacts viewers' responses related to character engagement, such as theory of mind [6–8] emotion recognition [9], and empathic care [10]. Shot scale assessment has been systematically related to viewers' rating on film mood and narrative engagement [11]. Furthermore, especially in the practice of art cinema, the preferences in the use of specific shot scales can be important indicators of a particular style: previous work [12] indicates that the statistical analysis of the overall shot scale distribution and transitions in films may reveal consistent and recurrent patterns in the works of a specific author. In [13] it is shown how this can even lead to performing automatic attribution of the movie's authorship starting from the statistical analysis of shot scale, which can be automatically computed as in [14,15].

Very few databases containing information about shot scale do exist. Several pioneering computational works rely on the Cinemetrics.lv database [16] to scrutinize the history of cinematic phenomena such as cut frequency in editing and shot scale (see for example [17]), examining how they vary across genres, historical patterns, etc. However, since Cinemetrics.lv provide various annotations for the same content without the possibility to visualize the related video shots, it is often difficult to relate and synchronize annotations with the visual content, especially among the different distributions of the same movie. Very recently the authors of MovieNet,
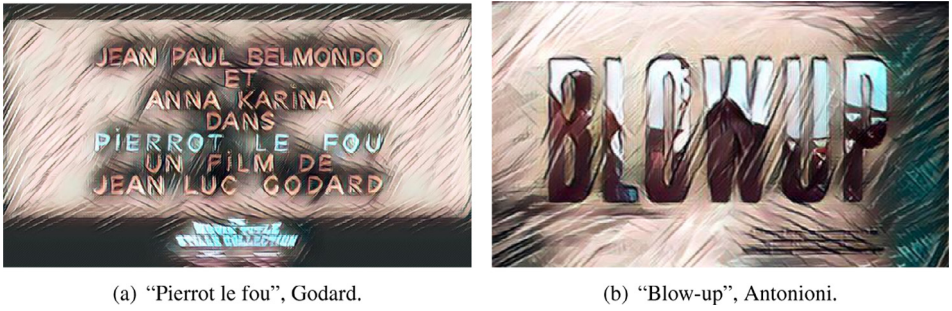
(a) "Pierrot le fou", Godard.

(b) "Blow-up", Antonioni.

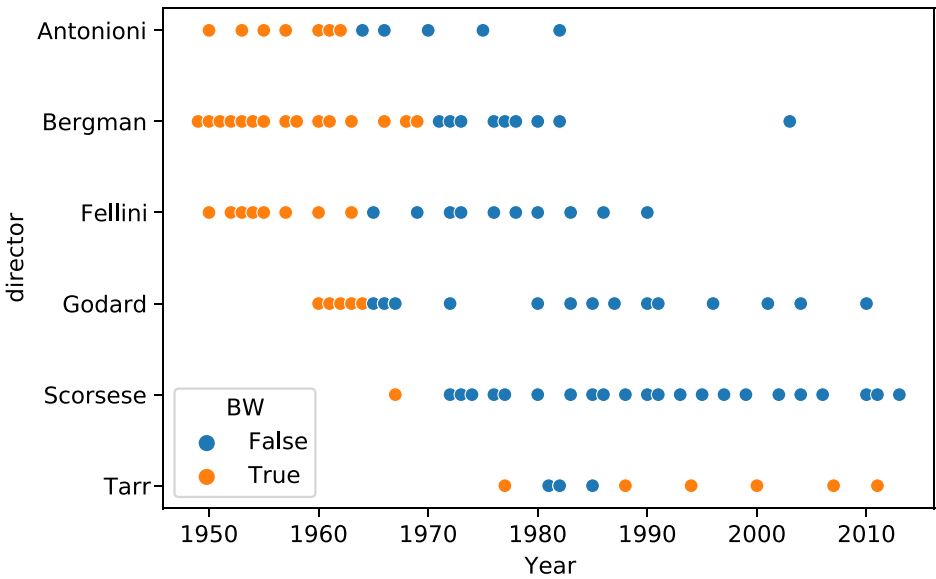**Fig. 3.** Examples of Insert Shots, adapted by [19].

Fig. 4. Distribution of the movies vs. the publication year. The orange dots represent black & white movies, while blue dots the ones in color. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

the massive project described in [18], totally annotated 47K shots from movies and trailers, each with one tag of view scale and one tag of camera movement. Although remarkable for its variety, the size of such dataset is still very limited if compared to the CineScale dataset.

1.2. Categories

In Fig. 1 we show some visual examples which illustrate how shot scale is mapped into the nine categories[1].

Seven classes shown in Fig. 1 be considered as main categories: Extreme Close Up (ECU), Close Up (CU), Medium Close Up (MCU), Medium Shot (MS), Medium Long Shot (MLS), Long Shot (LS), and Extreme Long Shot (ELS). Moreover, in this work we include two additional scales:

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[1] Original frames in Fig. 1 have been adapted by the method in [19] to avoid copyright infringement.

	SCORSESE		GODARD		BERGMAN
Year	Original title	Year	Original title	Year	Original title
1967	Who's that knocking on my door	1960	A bout de souffle	1949	Fangelse
1972	Boxcar Bertha	1960	Le Petit Soldat	1950	Till gladje
1973	Mean Streets	1961	Une femme est une femme	1951	Sommarlek
1974	Alice Doesn't Live Here Anymore	1962	Vivre Sa Vie	1952	Kvinnors vantan
1976	Taxi Driver	1963	Le Mepris	1953	Gycklarnas afton
1977	New York New York	1963	Les Carabiniers	1953	Sommaren med Monika
1980	Raging Bull	1964	Bande a part	1954	En lektion i karlek
1983	The King of Comedy	1964	Une Femme Mariee	1955	Kvinnordrom
1985	After Hours	1965	Alphaville	1955	Sommarnattens leende
1986	The Color Of Money	1965	Pierrot le fou	1957	Det sjunde inseglet
1988	The last temptation of christ	1966	Made in USA	1957	Smultronstallet
1990	Goodfellas	1966	Masculin feminin	1958	Ansiktet
1991	Cape Fear	1967	2 ou 3 choses que je sais d'elle	1958	Nara livet
1993	The age of innocence	1967	La chinoise	1960	Djavulens oga
1995	Casino	1967	Weekend	1960	Jungfrukallan
1997	Kundun	1972	Tout va Bien	1961	Sasom i en spegel
1999	Bringing Out The Dead	1980	Sauve qui peut la vie	1963	Nattvardsgasterna
2002	Gangs of New York	1983	Prenom Carmen	1963	Tystnaden
2004	The Aviator	1985	Detective	1966	Persona
2006	The Departed	1985	Je vous salue Marie	1968	Skammen
2010	Shutter Island	1987	King Lear	1968	Vargtimmen
2011	Hugo	1987	Soigne ta droite	1969	En Passion
2013	The Wolf of Wall Street	1990	Nouvelle Vague	1969	Riten
		1991	Allemagne annee 90 neuf zero	1971	Beroringen
	FELLINI	1996	For Ever Mozart	1972	Viskningar och rop
Year	Original title	2001	Eloge de l'amour	1973	Scener ur ett aktenskap
1950	Luci del varieta	2004	Notre musique	1976	Ansikte mot ansikte
1952	Lo Sceicco Bianco	2010	Film socialisme	1977	Das Schlangenei
1953	I Vitelloni			1978	Hostsonaten
1954	La strada		ANTONIONI	1980	Aus dem Leben der …
1955	Il Bidone	Year	Original title	1982	Fanny es Alexander
1957	Le notti di Cabiria	1950	Cronaca di un amore	2003	Saraband
1960	La Dolce Vita	1953	I vinti		
1963	Otto e mezzo	1953	La signora senza camelie		TARR
1965	Giulietta degli spiriti	1955	Le amiche	Year	Original title
1969	Satyricon	1957	Il grido	1977	Csaladi tuzfeszek
1972	Roma	1960	L'avventura	1981	Szabadgyalog
1973	Amarcord	1961	L'eclisse	1982	Panelkapcsolat
1976	Casanova	1962	La notte	1982	Macbeth
1978	Prova d'orchestra	1964	Il deserto rosso	1985	Oszi almanach
1980	La citta delle donne	1966	Blow-Up	1988	Karhozat
1983	E la nave va	1970	Zabriskie point	1994	Satatango
1986	Ginger e Fred	1975	Professione reporter	2000	Werckmeister harmoniak
1990	La voce della luna	1982	Identificazione di una donna	2007	A Londoni Ferfi
				2011	A torinoi lo

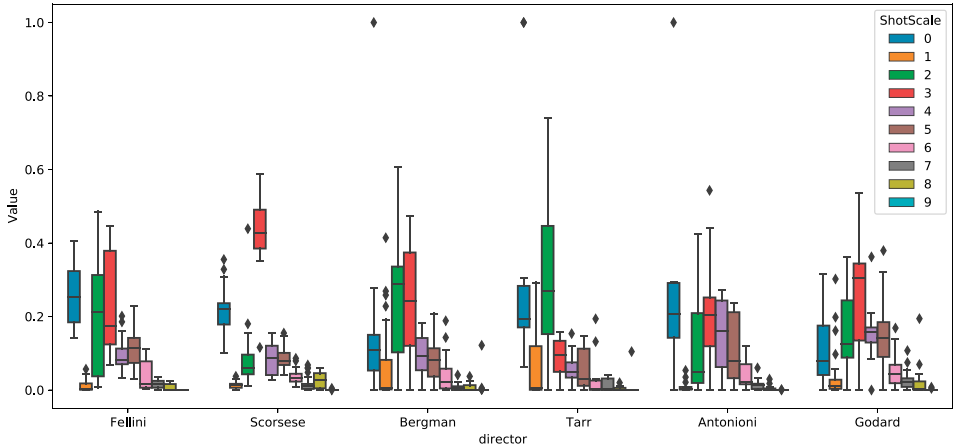**Fig. 5.** The full list of movies divided by director (original title and year of production).

Fig. 6. Shot scale distribution for each director (0=FS, 1=ECU, 2=CU, 3=MCU, 4=MS, 5=MLS, 6=LS, 7=ELS, 8=IS, 9=NA).

Table 1
Average number of frames per movie and average shot scale distribution for each director.

Director	Fr/mov (avg)	FS	ECU	CU	MCU	MS	MLS	LS	ELS	IS	NA
Antonioni	6,247.38	0.25	0.01	0.13	0.21	0.14	0.12	0.04	0.01	0.01	0.00
Bergman	5,24.19	0.13	0.06	0.24	0.24	0.09	0.08	0.04	0.01	0.01	0.00
Fellini	7,096.39	0.26	0.01	0.21	0.24	0.10	0.12	0.04	0.02	0.01	0.00
Godard	5,151.29	0.11	0.04	0.16	0.27	0.15	0.14	0.05	0.03	0.02	0.00
Scorsese	7,931.35	0.22	0.01	0.09	0.43	0.09	0.09	0.04	0.02	0.03	0.00
Tarr	8,894.90	0.34	0.08	0.31	0.09	0.06	0.06	0.04	0.01	0.00	0.01

Foreground Shot (FS), in which two different shot scales, at least two categories away from each other (e.g., ECU and MCU or longer, or CU and MS or longer), are found in the same image (see also examples in Fig. 2); and Insert shots (IS), which include frames with textual credits, producer logos, or with totally black background (see also examples in Fig. 3).

1.3. Data features

The full list of movies divided by director, with the year of production and original title, is provided in Fig. 5. Movies are approximately half in black-and-white (b&w) and half in color, since they cover more than 70 years of movie history (see Fig. 4).

The six directors are consensually considered highly unique and distinguishable in film historiography of author cinema; therefore, such artistic video presents a variety of experimental aesthetic situations, rich scene compositions, and often present unconventional and symbolic content.

Table 1 presents the distributions of shot scale for each director, which is also graphically rendered in Fig. 6

Fig. 7 represents the transitions between shot scale classes for each director, by means of transition matrices. Since scale is annotated each second, so as transition probabilities to different scales are pretty small, the values in the matrices are differently normalized depending on whether there is a transition to a different class or not, i.e., the probabilities of staying in the same class are normalized to the maximum value of intra-class transition (in blue, on the diagonal), while the probabilities to switch to a different class are normalized to the maximum value on inter-class transition (in red).
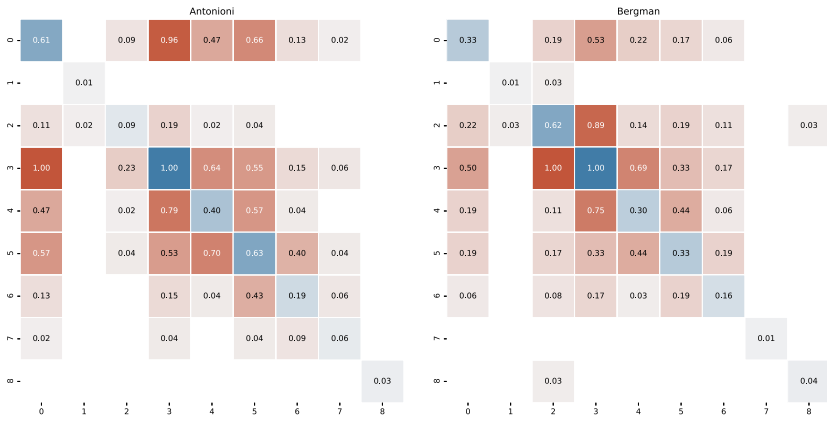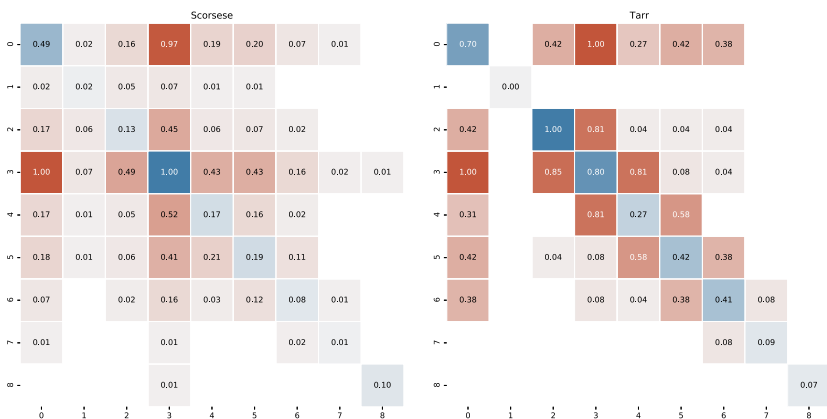
(a) Antonioni

(b) Bergman
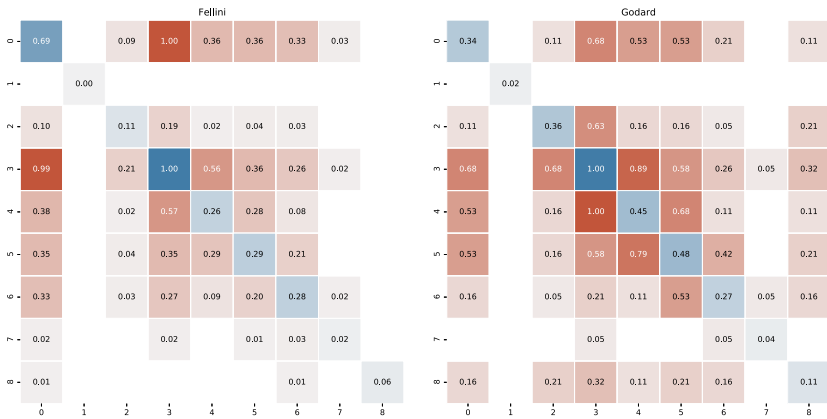
(c) Fellini

(d) Godard

(e) Scorsese

(f) Tarr

Fig. 7. Shot scale transitions @1fps for each director. Diagonal values (intra-class transitions) are normalized to their max value (blue). Inter-class transitions are normalized to their own max value (red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Attribute	Description
time	Time from the movie beginning
shotscale	Shot scale class, see next table

Code	Abbreviation	Class
0	FS	Foreground Shot
1	ECU	Extreme Close Up
2	CU	Close Up
3	MCU	Medium Close Up
4	MS	Medium Shot
5	MLS	Medium Long Shot
6	LS	Long Shot
7	ELS	Extreme Long Shot
8	IS	Insert Shots
9	NA	Not available

Fig. 8. Scheme description of data.

2. Experimental Design, Materials and Methods

2.1. Data extraction

Before being annotated, frames have been extracted at 1 fps, using ffmpeg version 3.4.8, from 124 full movies which correspond to the entire filmographies by 6 important film authors: Martin Scorsese, Jean-Luc Godard, Béla Tarr, Federico Fellini, Michelangelo Antonioni, and Ingmar Bergman. The resolution of 1 fps was chosen since a camera take may contain several scales in the same shot, e.g., whenever the camera or the objects in the image are moving.

Shot scale annotations were provided by three human coders (2 coders + 1 who made decision in case of disagreement) in tabular form, as shown in Fig. 8. Annotations can be retrieved from the Mendeley Data.

2.2. Materials

Among the additional material that can be retrieved on the project website we first mention the possibility to directly contact the author to request access to video frames, under fair use agreement. Additionally provided material includes the model and the code for building a Convolutional Neural Network (CNN) architecture for automated shot scale recognition. In particular, with respect to the CNN-based architecture, in [14] we tested three Convolutional Neural Networks with increasing capacity (AlexNet, GoogLeNet, VGG16) trained by an extensive hyperparameter selection process. All best performing CNNs use pre-computed weights from ImageNet and then are fine-tuned on the shot scale dataset. Among networks, VGG-16 performed best, resulting in 94% accuracy on the three scales. On the project website we include an updated version of the model that makes use of DenseNet, improving the overall accuracy by 3% with respect to the best model presented in the research article [14]. All related publications [11,13,14] containing a comparison with state of the art in the field can be also found on the same project website.

Ethics Statement

No human subjects were involved in this work.

CRediT Author Statement

Mattia Savardi: Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing review & editing, Visualization; **András Bálint Kovács:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation; **Alberto Signoroni:** Methodology, Investigation, Resources, Writing review & editing, Supervision, Funding acquisition; **Sergio Benini:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing original draft, Writing review & editing, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

Acknowledgements

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