dr Dagmara Gałajda

Institute of Linguistics

University of Silesia in Katowice

https://orcid.org/0000-0002-1478-8172

Katarzyna Matlas

College of Interdisciplinary Individual Studies

University of Silesia in Katowice

https://orcid.org/0009-0001-8066-5525

Klaudia Otrębska

College of Interdisciplinary Individual Studies

University of Silesia in Katowice

https://orcid.org/0009-0004-4890-4102

Kamil Wałczyk

College of Interdisciplinary Individual Studies

University of Silesia in Katowice

https://orcid.org/0009-0001-5287-8339

Eco-themed hashtags in social media. Their characteristics, roles and links based on
examples of posts from Twitter/X and Instagram

Katarzyna Matlas, Klaudia Otrębska, Kamil Wałczyk, Dagmara Gałajda

Uniwersytet Śląski w Katowicach

Kolegium Indywidualnych Studiów Międzyobszarowych Uniwersytetu Śląskiego

w Katowicach,, Wydział Humanistyczny

Abstract

It seems that eco-themed content makes up a sizable proportion of social media posts. It is interesting to find an answer to the question of whether the hashtags chosen by the creators of eco-themed posts are a certain closed catalogue and whether these main hashtags, in this study chosen from among the anglicisms, occur surrounded by other specific hashtags attributed to the eco content in question. The following text presents preliminary research focusing on the nature, role and interrelationships between hashtags in eco-themed posts using the example of posts from two of the most popular social media today, Twitter/X and Instagram.

Keywords: hashtag, social media, communication, ecology

Theoretical background

Social media have for many years now become the main source of information, especially for the youngest generations, namely Generation Z and Alpha (Pearce et al. 2014, Haunschild et al. 2019). Consequently, the discourse that takes shape in the online space updates what is being talked about and read/listened to. Often social media has more clout and reaches a larger audience than, for example, politicians (Ojala & Lakew, 2017). Therefore, research on how content related to important issues is communicated should be cross-cutting,

taking into account linguistic as well as social issues. Environmental discourse currently has a rather bad reputation, which is linked to the phenomenon of greenwashing and a generally negative approach to extending reach through catchy topics (Zywica & Danowski, 2008). In places, it even appears in the form of anti-environmental discourse. Nevertheless, green topics are most easily discussed with the general public via social media, enriching them with such well-received visual prompts. Finally, the very notion of the hashtag is a sure signpost to find the content we are interested in and with which we want to reach people with similar views and interests, asking similar questions. Therefore, we believe that in order to understand the mechanism of the eco-discourse, we need to explore the tagging of content by social media users (Penz & Fill, 2022).

Methodology

The idea for the research began by collecting the most common anglicisms related to eco discourse (Table 1). The anglicisms were collected by reviewing more than 400 eco-themed posts in Polish on Instagram and Twitter/X, and by interviewing 5 people declaring an interest in ecology and living as green and climate-friendly as possible. Surprisingly, the list of anglicisms turned out to be quite short. The order in the table is random - every anglicism encountered has been noted.

zero waste	Fleksitarianie	solar energy

greenwashing	Slow food	organic food
go green	Raw food	fair-trade
recycling	Head to tail	biodiversity
upcycling	No waste	biomass
eco-friendly	Opakowanie refill	fast fashion
vege/vegan	Organic	GMO
bio	car pooling	freeganizm
eco	ecosystem	
be green	cruelty free	

Table 1. List of Anglicisms occurring in the corpus

When collecting the corpus, it became apparent that anglicisms mostly occur not as part of a post but rather as hashtags. This led to the main topic of this research of ours, i.e. the role, nature and links between eco-themed hashtags in Twitter/X and Instagram posts.

The study was carried out over several weeks in September 2023. The 27 anglicisms from Table 1 served as the main hashtags we typed into the Twitter/X and Instagram search engines. We labelled the number of posts that popped up (Table 2, but only for Instagram, as Twitter/X does not report the number of posts with a given hashtag unless it is trending), the language (mainly English 80%, with a small amount in German 10%, French, Russian,

Ukrainian and Polish 10%) and then checked the hashtags under the first 10-15 most popular (i.e. those that popped up first in the search) posts. In this way, we combined each of the 27 main hashtags with others with an environmental theme, learning about the preferences and mindset of social media users.

	nr of posts		nr of posts		nr of posts
zero waste	10,9 mln	Flexirianism	1000+	solar	5,7 mln
greenwashing	133 thousand	Slow food	2,7 mln	freeganizm	5000+
go green	9,1 mln	Raw food	4,5 mln	fair-trade	3,9 mln
recycling	3,7 mln	Head to tail	5000+	biodiversity	2,6 mln
upcycling	6,3 mln	No waste	1,1 mln	biomass	99,2 thousand
eco-friendly	20,8 mln	refill	1,3 mln	slow fashion	38,9 thousand
vegan	127 mln	Organic	59,1 mln	GMO	428 thousand
bio	13,7 mln	car pooling	49,2 thousand		

eco	9,4 mln	ecosystem	849 thousand		
be green	346 thousand	cruelty free	22,7 mln		

Table 2. The number of posts that popped up when the main hashtag was entered

All data was collected in an Excel sheet and then analysed to find the answers to the research questions:

RQ 1: Do all 27 hashtags labelled as main ones generate a similar number of eco-themed posts?

RQ 2: Are the resulting hashtag groups around each of the 27 hashtags labelled as main ones of similar size?

RQ 3: How are the themes within each group structured?

RQ 4: What linguistic practices can be observed among the hashtags in the groups?

RQ 5: Are there differences between the results from Twitter/X and Instagram? If so, what are they, and how do they relate to the content in RQs 1-4?

Discussion

We collected a corpus of nearly 3,000 hashtags, of which nearly 1,000 came from Instagram posts and 2,000 from Twitter/X. The hashtag groups that emerged from the 27 hashtags labelled as the main ones varied in number and in language. In the case of Twitter/X,

the groups averaged between 50 and 100 elements (the smallest being #solar, at just 36, the largest being #slowfashion, at almost 130). For Instagram, the groups were less numerous, averaging between (least #biodiversity and #flexitarianism, #headtotail, #rawfood, #refill, #carpooling, #bio, #upcycling, all over 20) 30 and 40. The responses from Twitter/X show more play with language, e.g. #stepoutofyourcomfortzone, #generationrestoration, #freegantrashtour. Hashtags on Instagram within the group oscillate around a similar theme. Below are examples of the most interesting analyses of individual hashtags from both Instagram (A) and Twitter/X (B).

A

When it comes to the figures of the usage of such anglicisms, the most commonly used is #vegan, as it appears in 127 mln posts. Primarily, it is used in food recipe-related content. What is compelling is that this hashtag is not used in vegan-related recipes only. It is sometimes used in vegetarian recipes or even in meat usage. Hashtags often used with the #vegan one are #plantbased, #veganism, #crueltyfree, #ecofriendly, #organic, #pigsarenotfood, #healthymeals, #consciousness. It proves that people associate veganism with something profitable for our planet as it reduces cruel rearing, improves people's health, and makes people more conscious not only about what they eat but also about where it comes from and what effects it has on the Earth. Even though it is not always used correctly, the popularity of this hashtag signifies social media trends which promote healthy and eco-friendly lifestyles. Two generations have the most powerful impact in such cases: Millenials and Generation Z. It also

signifies that most social media users are conscious of the existence of veganism and its benefits.

Hashtag #bio is very popular with the figure of 13,7 mln. However, it is mostly used in spam marketing. Rarely are there posts which contain Anthropocene issues' data. A conclusion that many people do not acknowledge the importance of bio-related content may be drawn from this. Some of the hashtags used with #bio: #microgreens, #vegan, #groworganic, #rawfood, #nature, #agriculture.

#zerowaste is crucial for social media platforms. It is commonly used. On Instagram, there are 10.9 mln posts with this hashtag. The content related to this hashtag is eco-friendly concerned and focuses on zero-waste promotion. It can often be observed among Generation Z representatives. Hashtags related to this one are plentiful, but here are some examples: #zerowastefood, #foodsustainability, #ecofood, #savetheplanet, #plasticfreeliving, #ecofashion, #reuse, #wildlife. According to this, people are truly concerned about all the aspects of the Earth's good governance. People do not only pay attention to food but also fashion, plastic usage and wildlife are asserted.

#greenwashing is not as popular as it may expected to be. The amount of its usage is 133 thousand. However, it emphasises the most important issues: fast fashion, plastic pollution, fast food, and climate change.

#freeganizm does not often appear on Instagram. It means that not many people know of the possibilities of freeganism and its positive impact on our planet. However, posts marked by this hashtag mostly concern eco issues and promote going on so-called skips and food sharing. Hashtags often used with #freeganism: #freegan, #reduction, #reducewaste, #eattrash,

#dumpsterdiving, #foodisfree, #lesswaste, #somebodystrashissomebodystreasure. Some of them have a certain dose of irony or humour, which should encourage people to try 'diving in a dumpster' and not to waste so many products.

Even though #fairtrade (3.9 mln) is popular, #slowfashion (38.9 thousand) did not gain so much credibility. Fairtrade is not only about fashion, but it is often associated with it. People know its meaning, but they may not know the difference between fast fashion and slow fashion. It may be said that they are not even conscious of the existence of such terms as slow fashion. More and more people create their own small businesses on Instagram, and that is the most common case of the usage of #slowfashion. Small clothes and accessories brands use it in their posts' descriptions. Hashtags which often appear with #slowfashion: #sustainablefashion, #handmadeeverything, #slowknitting, #naturalfibers, #memade, #shopsmall, #homegrownbusiness.

B
#zerowaste

Zero Waste - Ensuring the protection of all resources involves caring for the environment and public health through responsible production, consumption, reuse, and recovery of all products, packaging, and materials while avoiding their incineration and preventing any discharges into the soil, water, or air that could pose a threat to the environment or human health.

Zero waste hashtag on X platform (formerly Twitter) resembles activities known to social movements. Other tags that have appeared in relation to zero waste were mostly short catchphrases, which encapsulate in a comedic way the way that people fight with overflowing waste. "Saynotoplastic" or "Breakthestraw" are used in a metaphorical and intentional way to minimalise the usage of plastic. Other tags are closely related to the activity of composing and mindful waste disposal. Posts in which those tags appeared were made by people using those ways - they often showed how they do it and shared tips.

#slowfashion

Slow fashion - encompasses an awareness and approach to fashion that carefully considers the processes and resources required to make clothing. It advocates for buying better-quality garments that will last longer and values fair treatment of people, animals, and the planet along the way.

Slow fashion on the X platform appears in collocations with other tags about women-led businesses or small businesses. Slow fashion entails empowering oppressed groups such as ethnic minorities and women by incorporating folkloristic themes into hand-made clothing. Tags describing clothing often allude to women's fashion choices, such as sweaters, dresses and jewellery. Thus, one can interpret slow fashion tags as posts of oppressed minorities trying to empower themselves and make a friendly and welcoming community.

#GMO

GMO is a genetically modified organism whose genome has been engineered in the laboratory in order to favour the expression of desired physiological traits or the generation of desired biological products.

Tags associated with GMO speak about mindful eating habits and choosing more plant-based food. Meat is not environmentally friendly as producing it involves cruelty to animals and more CO_2 production. Meat is also considered by scientists to be a product which will be lacking in future decades. Collocations also include sayings such as "publichealthcrisis" and "healthydiet" to connect GMO to their not well-known but otherwise harmful impact on one's body.

#biodiversity

Biodiversity encompasses the various forms of life coexisting within a particular region, including animals, plants, fungi, and even tiny microorganisms such as bacteria that constitute our natural environment. These species and organisms collaborate within ecosystems, forming interdependence that facilitates life. Biodiversity plays a crucial role in providing all the essential elements for survival in nature, including food, clean water, medicine, and shelter.

Biodiversity tag shows many photos of animals, plants, and other life species people could observe on earth - tagging the shown animal, describing from what geographical area it is and encapsulating the fleeting moment of a photo-capture. This tag seems to be working as a raising awareness movement - to show casual users of X the beauty of our world that is endangered

by environmental crisis, which is indicated by tagging such as "extinction" and "tiredearth."

#biomass

Biomass, in an ecological context, refers to living organisms, whereas in the context of bioenergy, it refers to material derived from organisms that are recently deceased.

It seems that a biomass tag is collocated with alternative fuel discourse. Except for tags such as "biofertilizer" and "agriculture", we may also see many tags relating to circular economy, regenerative farming and, by a large margin, cannabis production. It seems that biomass is considered a good source of sustainable energy and is closely related to hemp farmers ("#hempfarmers")

#fairtrade

Fair trade a way of buying and selling products that make sure that the producers and distributors receive an adequate price for their involvement in the production and distribution. It encompasses the spirit of equality and justice in the trade.

By the analysis of the tags that appeared with the Fair Trade tag, it may be concluded that Fair Trade is closely associated with Christianity or other religious practices. It would not be unwise to disclaim the connection of the Christian teaching of fairness and love with the idea of fair trading. It seems that local communities specialise in fair trade. It is more seen in family businesses in highly religious parts of the world, which is shown by the amount of "gospel". "church", "prayer", "localbusiness", "familybusiness" and "independent", and other

related   tags   that   appear   with   fair   trade   focused   posts.

#freeganism

Freeganism is an ideology of limited participation in the conventional economy and minimal consumption of resources, particularly through recovering wasted goods like food.

Freeganism on X is portrayed as a lifestyle which is mostly held by teenagers and young adults, which may be interpreted from co-existing tags such as: "teen" or "teenager". It is seen as a type of movement in which people encourage each other by sharing their findings in the dumpster "dumpsterfinds". Many of them also shared other characteristics of their persona ("vegan", "asexual", "survivalist") and having a youtube channel on which everything is documented is a common occurrence ("youtuber", "like", "subscribe", "videos", "smallchannel", "newuploads").

#solar

Solar (power) is an adjective relating to the usage of the energy from the sun to produce electric power.

It was hard to analyse the solar tag on Twitter, as it is also the name of a song from a popular Korean music group known as MAMAMOO. Otherwise, not-music-related posts described a way of mindful farming which incorporates solar energy to power the watering systems ("Grovefuturefarmingsolutions")

#flexitarianism

Flexitarianism, also called semi-vegetarianism, is a dietary restriction that is centred on plant foods with the occasional inclusion of meat.

Flexitarianism on X is related to sharing recipes from native country's cuisine ("indian", "themediterraneandish") and encouraging other users to try reducing the amount of meat in their diet by sharing creative ideas to enrich the number of vegetables in their diet ("meatlessmonday", ''eatyourveggies", "funfitfood")

#rawfood

Raw food - that is eaten uncooked, that has not yet been cooked, or that has not been cooked enough.

Raw food tag is associated with sharing the products of nature which can be eaten without preparing ("sprouts", "chiaseeds", "herbal"). It also places huge importance on sustainable eating - preparing only as much food as will be really consumed ("sustainability", "organicfood")

#slowfood

Slow food is a movement to prevent the disappearance of local food cultures and traditions by that is producing or preparing food in accordance with local culinary traditions, typically using high-quality, locally sourced ingredients.

Slow Food on X focuses on promoting local distributors of high-quality products ("irishfarmhousecheese", "canadianoysters"). Slow food movement also promotes mindfulness ("mindfulness", "slowtravel") and while empowering local businesses it romanticises the daily life ("supportlocal", "aquaculture", "thegoodlife", "tealife", "arts").

#headtotail

Head to tail is a way of sustainable eating as it refers to the preparation and consumption of the whole animal as opposed to just the choice parts.

Head to tail promotes eating everything that an animal has to offer so their death would not be "a waste" ("everybitisprecious"). It is a form of showing respect towards dead animals. Other tags which dominate head-to-tail movement are connected strictly to those rarely eaten pieces of meat - "wholehog", "piguterus", "pigwhistle" - to encourage others and show that while eating meat, one should not be picky about the parts they eat as it is not environmentally friendly and does not support the ideology of circle of life.

#nowaste

A synonym for zero waste movement is showing the experiences of people who eat food even if it is expired ("expirationdates") and recycle food to ensure no waste ("foodwasterecycling", "stopfoodwaste"). Excessive production of food contributes to mass waste and environmental problems by overusing natural gifts and producing CO_2, zero wast and no waste encourage people to be mindful of their dietary choices ("foodliteracy", "proplanetpeople")

#organic

Organic, in relation to farming methods describes food production without the use of chemical fertilizers, pesticides, or other artificial chemicals.

Organic tag encourages a holistic approach to life by producing at least a part of the food by yourself "gardenerlife", "holistic", "gardeningtwitter". It emphasizes the advantages of growing your own food and using non-modified products to increase your immunity and life expectancy. ("naturalprodcts", "healthandwellness")

#refill

#refill appears to be focused on sustainability and reducing waste, particularly plastic waste. Numerous of the related hashtags are focused on environmental issues and reducing pollution. The matter of personal care and well-being is also addressed but with a focus on sustainability. It includes hashtags, such as "takingcareofyourself", "mentalhealthmatters", "selfcare", "youmatter", "balance", "selflove", and "recharge". Hashtags related to business and technology are also present, but these are often related to sustainability and reducing waste as well. Overall, the mood of the hashtag seems to be positive and focused on making an impact on the environment and personal well-being.

#ecosystem

Ecosystems are characterized by dynamic interactions and interdependencies among the biotic (living) and abiotic (non-living) elements, contributing to the balance of ecological processes.

Predominantly #ecosystem is concerned about the environment and the impact of human activities on it, such as deforestation in the rainforest areas, rising ocean temperatures, and forest fires. Hashtags, such as "madampe", "srilanka", "odisha", "usa", and "siliconvalley", suggest that the posts are also interested in exploring how environmental issues are affecting different parts of the world.

A certain amount of hashtags co-occurring with the #ecosystem were related to technology, such as #blockchain, #ai, #artificialintelligence, #automation, #generativeai, #technology, #5g, #cloud, #openaichatgpt, #data, #utilitytoken, #stability, #web3, and #digital. Which may not be in every respect related to the environment but rather to the network of technologies, tools, frameworks, and entities involved in the development, deployment, and utilization of artificial intelligence and services that work together to provide a complete and unified user experience.

#carpooling

Carpooling is the concept of sharing your car to accommodate more than one person at a time, eliminating the need for riders to drive themselves in separate vehicles.

The mood of the hashtag "carpooling" on X appears to be positive and focused on saving money, reducing pollution, and promoting sustainable transportation. The presence of hashtags related to alternative modes of transportation, such as cycling and walking, suggests that users of X are interested in exploring different ways of commuting.

#crueltyfree

"Cruelty-free" label ensures that the testing process of certain products did not involve harm or cruelty towards animals. This term is commonly associated with cosmetics and personal care products. Hashtags on X related to animal welfare are used in campaigns to ban animal testing, and the vast majority of them are used in conjunction with #crueltyfree in social media posts.

#begreen

Being green puts focus on reducing waste and acting in a way that does not harm the environment. The mood of the hashtag "begreen" on Z is positive and inspiring. The use of hashtags such as #bebold, #beblessed, #bebrilliant, and #bebetter suggests that users are motivated to make a positive change and are looking for ways to improve themselves and the world around them. The use of hashtags, such as #pray, #helpvictims, and #spreadlove, also suggests that people are concerned about the well-being of others and are looking for ways to make a positive impact.

#eco

As with #begreen, being eco puts the emphasis on reducing waste and promoting a lifestyle that is not harmful to the environment. The vast majority of hashtags appearing along with #eco share a common theme of sustainability, eco-friendliness, and nature. Many of the hashtags relate to sustainable living, such as #lowimpactliving, #sustainableliving, and #doyourpart. Other hashtags relate to eco-friendly products, such as #bamboo, #degradable, and #organic. There are also hashtags related to nature, such as #nature", and #ecovillage. A certain amount of the hashtags are related to specific industries, such as #hairbeauty, #brush, #manufacturers,

and #comb. Others are related to specific events or products, such as #barbiemovie, #awards, and #filmproduction.

#bio

Themes of the co-occurring hashtags on X may be divided into five main sections, such as organic farming and nature, health and pharmaceuticals, children and organic lifestyle, science and medical fields, and pop culture and leisure. The sentiment associated with #bio and its related hashtags is notably positive, with an overarching theme of organic living, environmental consciousness, and scientific exploration.

#greenwashing

The act of making false or misleading statements about the environmental benefits of a certain product or practice while not acting in an environmentally sound way is considered greenwashing. Key correlations within this discourse highlight environmental concerns as #climate and #climatechange were frequently used alongside #greenwashing, as well as #hypocrite was often used together, indicating a scepticism towards purported green initiatives by big corporations. A diverse range of emotions may be spotted within the discourse, as environmental issues regarding fossil fuels and plastic pollution predominate the posts on X.

#gogreen

#gogreen may be seen as an encouragement towards a more environmentally friendly lifestyle. Analysis of the co-occurring hashtags reveals the most common themes, such as environmental

protection, sustainability, and climate action. Many of the hashtags focus on reducing waste, using renewable energy, and living an eco-friendly lifestyle. There is also a strong emphasis on protecting the planet and its biodiversity, with hashtags such as #savetheearth, #biodiversity, and #reforestation. A sense of urgency may be noticed, as #climateemergency and #climateactionnow indicate that users are aware of the need to take action quickly to address climate change. Additionally, there are hashtags related to solar power and renewable energy, suggesting that there may be interest in finding alternative sources of energy to reduce their carbon footprint.

#recycling

Discourse regarding #recycling may be seen as positive, with a strong emphasis on sustainable practices and innovative solutions.

#upcycling

Upcycling may be defined as a practice of reusing unwanted materials and turning them into new products, thus reducing waste. Certain hashtags (such as #sustainablefuture, #waronwaste, and #waronplastic) used with #upcycling reflect that it may be a way to reduce waste and plastic consumption and contribute to a sustainable future. DIY and fashion posts predominate upcycling community, it seems as if it is treated as a way to express creativity and individuality.

#vegan

Users of X see #vegan as a way to promote a plant-based lifestyle, animal rights, and environmental protection. As well as to share recipes, fitness tips, and information about vegan products and services. The mood may be seen as positive; however, some uses of #vegan appear to be critical of meat-eating and the meat industry, which is reflected in hashtags such as "meateaters", and "chickenwings".

#ecofriendly

#ecofriendly seems to be synonymous with #eco. However, the former was more frequently occurring in posts related to small businesses, entrepreneurship, and services, such as #smallbusiness, #etsy, #factoryvisit, #toiletpipes, #cartracker, and #lenovo, which suggests that eco-friendly and sustainable options are becoming more widely available in a variety of industries.

The main way to develop the present study would be to explore qualitative analysis, e.g. using software such as LIWC-22 or LancBox, and complement it with statistical analysis. Checking eco-themed posts and related hashtags in other social media such as Facebook also seems like a good idea. Given that Facebook users are mainly Millenials, such a study could point out some differences between Generation Y and Gen Z, who are much more likely to use Instagram and Twitter/X.

Another idea for a follow-up study is to test the differences and similarities between eco-themed photos and the hashtags describing them, where both photos and descriptions will

be generated by humans and artificial intelligence. We have piloted such a study, but have not yet analysed the results. We believe that combining the results of such research with those described in this text would provide an interesting insight into the nature and role of hashtags in the context of the very current discussion on AI-generated content.

As mentioned, this study is an introduction to the research on the nature and role of hashtags in eco-discourse. The very design of the study on this topic and the collection of data for the corpus, shows how difficult it is to study linguistic phenomena in social media, especially in such a popular and vast topic as ecology. Texts originating from social media change all the time at a very fast pace, and thus data collected over a small stretch of time may differ from each other, as may those generated by different algorithms tuned, for example, to the user-researcher's profile. A procedure such as creating a brand new social media account may not be sufficient, as we are aware that portals often collect information from other applications installed on the device. This may result in results tailored to the searcher in the first place, i.e. biased results. Nevertheless, we trust that this kind of research, even if to some extent dependent on the complex mechanisms behind content personalisation and the creation of filter bubbles, develops the awareness of researchers and Internet users and is an example of interdisciplinary action.

Bibliography

Berger J, Milkman KL (2012) What makes online content viral? *Journal of Marketing Research* 49(2), 192–205.

Faunalytics (2021, April 30). Twitter Trends: #CageFree, #Vegan, #AnimalRights, and More!. https://doi.org/10.31234/osf.io/gpcyd

Hansen LK, Arvidsson A, Nielsen FÅ, Colleoni E. (2011). Good friends, bad news-affect and virality in Twitter. *Future Information Technologies* 185, 34–43.

Haunschild, R. Loet Leydesdorff, Lutz Bornmann, Iina Hellsten, Werner Marx, (2019) Does the public discuss other topics on climate change than researchers? A comparison of explorative networks based on author keywords and hashtags,
Journal of Informetrics, Volume 13, Issue 2, https://doi.org/10.1016/j.joi.2019.03.008.

Moser, SC (2010) Communicating climate change: History, challenges, process and future directions. *WIREs Climate Change* 1, 31–53.

Ojala, M. & Lakew, J. (2017). Young People and Climate Change Communication. *Oxford Research Encyclopedia of Climate Science*. DOI: 10.1093/acrefore/9780190228620.013.408

Pearce W, Holmberg K, Hellsten I, Nerlich B (2014) Climate change on Twitter: Topics, communities and conversations about the 2013 IPCC Working Group 1 Report. *PLoS ONE.*

Segerberg A, Bennett WL (2011) Social media and the organization of collective action: Using Twitter to explore the ecologies of two climate change protests. *The Communication Review* 14(3), 197–215.

Small, T.A. "What the hashtag? A content analysis of Canadian politics on Twitter." *Information, Communication & Society* 14 (2011), 872–895.

Penz, H. & Fill, A. (2022). Ecolinguistics: History, today, and tomorrow. *Journal of World Languages*, *8*(2), 232-253. https://doi.org/10.1515/jwl-2022-0008

Weller, K., Bruns, A, Burgess, J., Mahrt, M., & Puschmann, C. (2014). *Twitter and Society*. Peter Lang.

Veltri, G.A.; Atanasova, D. "Climate change on Twitter: Content, media ecology and information sharing behaviour." *Public Understanding of Science* 26 (2017), 721–737.

Zywica J, Danowski J (2008) The faces of Facebookers: Investigating social enhancement and social compensation hypotheses; Predicting Facebook and offline popularity from sociability

and self-esteem, and mapping the meanings of popularity with semantic networks. *Journal of Computer-Mediated Communication* 14(1), 1–34.