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From Controversy to Credibility: The Crucial Role of Spokespersons in the Digital Age

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Abstract- One of the main challenges facing spokespersons in the digital era is the intensity of media and public spotlight and scrutiny in which any statement will be analyzed and criticized openly. The other equally important challenges are keeping message consistency in various digital platforms and ensuring harmony with the core values of the organization. Answering journalists is nothing more than a technical affair but requires tranquility, a holistic mind, and deep knowledge about the context of the surrounding situation. In transparency pressure, spokespersons are not easy because they must be able to keep a balance between information transparency and policy in maintaining the integrity of sensitive data. Digital platform transformation has decentralized information flow, strengthened public scepticism, and increased the risk of social conflict as a result of controversial speech or video. Additionally, it has brought about a serious implication on speech etiquette. In this context, the application of strategic communication becomes a crucial strategy in the digital age, requiring approaches that are not merely reactive but also systematically designed, adaptive to the emerging dynamics, measurable to achieve it, and constantly based on strong communication ethics. Moreover, strategic communication plays a significant role in strengthening institutional legitimacy and building enduring public trust in the long run. These research findings underscore the need to develop a collaborative, cross-functional, and cross-sectoral strategic communication ecosystem in order to improve the effectiveness of message delivery and the credibility of the institution in responding to communication challenges that demand speed, real-time, transparency, and social sensitivity.

Keywords: Spokespersons, Strategic Communication, Controversy, Credibility, Crucial Role, Digital.

Introduction

In the increasingly complex globalization development, the presence of institutions, organizations, or corporations needs the role and function of spokespersons capable of presenting their existence and engagement with their public. Agree it or not, the role of spokespersons in the era of multi-real-time is increasingly crucial. On one hand, they become representative or face of institution or corporation, while on the other hand they play a role as the guardian of public trust. The position makes spokespersons a strategic communicator and manager of information in the digital and disinformation era.

In fact, although many people agree with the important role of spokespersons not all of them know well the profile of spokespersons, much less their crucial role as a face and mediator of an organization and corporation in case of a conflict with the public. The crucial role is apparent in crisis communication and public diplomacy. Spokespersons are often seen as those who have expertise in avoiding difficult questions and providing media interviews. Globally, the role of spokespersons both in the government and corporate sectors has developed in line with the globalization development and the need for effective and transparent communication.

Some spokespersons have successfully played their role, including Johan Budi when he served as a spokesman for the Corruption Eradication Commission (KPK) in the 2006–2014 period. He has been the longest-serving spokesperson up till now (eight years). The acknowledgment of the KPK spokesman's role is evident from the award he received from the ASEAN Public Relations Network in June 2014, as reported by Tempo.co in June 2014.

Thereafter, he was promoted to become spokesman for Indonesian President Joko Widodo for three years (2016 – 2019). ANTARA news agency quoted communication expert Suko Widodo of Airlangga University in Surabaya as saying in January 2016 that Johan Budi deserved the post of presidential spokesman because he was able to improve the reputation of the presidential institution. According to Suko Widodo, Johan Budi has a high level of trust in the eyes of the public as well as expertise in communicating with the public, especially the media.

On the other hand, Hasan Nasbi, spokesman for President Prabowo Subianto, is often seen by the media as having some controversies, particularly since his term of office was less than one year, and he resigned. However, he was again appointed to the post following a polemic in the national mass media. One of the controversies started when Hasan Nasbi commented on an incident involving a package of a pig's head sent to a national mass media publication, which described it as an act of terror. The comment sparked a wave of criticism, including on social media. Kompas.co reported in April 2025 that Hasan has come under fire for lacking sensitivity and underestimating a potential threat to press freedom.

It seems that the role of credible spokespersons is increasingly needed to support the government's main programs, including free nutritious meal program that has much sparked controversy, for instance, when it comes to a lack of public dialogs, a lack of credible technical explanations, emotional narratives, a lack of data, as well as fragmented rather than single spokespersons.

The interesting phenomenon is that many spokespersons come from journalism. In Indonesia alone, the role of spokespersons can be traced to the New Order regime under the leadership of President Soeharto. The role of spokespersons in Indonesia evolved to become formal in the era of President Abdurahman Wahid's government from 1999 to 2001. There were four spokespersons at that time; they were (1) Wimar Witoelar; (2) Adhie Massardi; (3) Yahya Cholil Staquf, and (4) Wahyu Muryadi. Although the post of spokesperson had not been provided for in the government's nomenclature at that time, the step marked the formal introduction of the spokesperson's role in the Indonesian government. Interestingly, three of the four spokespersons have a journalistic background.

The crucial role of spokespersons points to their position as "the face" of an organization or corporation that frequently interacts with the media and makes public appearances. Any statement and action of spokespersons directly reflects the image and reputation of the institution they represent. After all, globally, there is stigma strongly embedded in the profile of spokespersons in that they must defend their superiors, organization, and corporation without paying attention to the context, public sentiment, and truth aspects.

In fact, negative views on spokespersons have long become the material of public discussion. US crisis communication expert Timothy Coombs pointed out that the issue resulted from a lack of sincerity, the emergence of an ethical problem, and a misguided meaning of loyalty. The rising public scepticism about government or corporate spokespersons is inseparable from the history of scandal and mismanagement of information. Records on the scandal and public lie will become unforgettable history.

The many cases in which corporate or government officials provide misleading or inaccurate information cause the public to lose trust and raise public scepticism about formal communication. The terms disinformation and media manipulation emerged in the digital age. The public is

increasingly aware of spokespersons manipulating narratives, along with the development of digital media and information dissemination algorithms. Spokespersons are very often used as a shield to cover officials' mistakes or the corporation's interests that increasingly tarnish the public's negative perception. (Livingston, 2018).

Several examples of scandals that worsen public trust in spokespersons include the Watergate Scandal (1972-1974), where the White House systematically covered a political crime, causing the public to lose trust in the US government. The other scandal is Facebook - Cambridge Analytica data scandal (2018), where a spokesman for Facebook repeatedly denied involvement in the abuse of user data, and later it turned out to be true.

A survey conducted by the Indonesian Survey Institute (LSI) in 2023 shows that public trust in government communication dropped by 15 percent compared to the previous year as a result of a controversial question considered unsolvable and even hurting people's feelings. This affirms the need for a spokesperson's sensitivity in responding to political issues. When controversy and speculation are spreading, an interesting phenomenon sometimes emerges in cyberspace, such as the "no viral, no justice" phenomenon. Although the phenomenon is not new, it has extraordinary allure because law enforcement will be conducted only if there is public pressure due to massive dissatisfaction and attention from the public.

In fact, in the digital age, spokespersons do not merely convey information but also manage crisis, encourage trust and safeguard the organization's image. The speed of information dissemination in the digital age may increase the impact of statement conveyed. One of the significant aspects that draws attention is how spokespersons can maintain credibility amidst various controversies. It seems that spokespersons lost their soul, so they need contemplation to regain their legitimacy since the status of spokespersons in the perspective of leadership communication is a leader in communication.

Ronald D. Smith (2021), in his book titled *Strategic Planning for Public Relations*, stressed that a spokesperson is determined by credibility, clear message, and how the strategy of conveying messages is conducted. This aligns with the principle of leadership communication introduced by Deborah J Barrett in her book titled *Leadership Communication*, which explains the strategic communication role conducted by a leader (Barrett, 2014).

Legitimacy is closely related to public trust. The public that trusts in a spokesman's statement will accept it as a piece of legal and publicly acceptable information. Additionally, it will also be easier to implement the information in the form of concrete action and will have a positive impact. (Putnam et al., 1993). On the contrary, the public's low trust may lead to a refusal of the information conveyed. A spokesperson shoulders the burden and has responsibility as a key of the organization to develop strategic communication as part of efforts to achieve the goal of the organization or business. The strategic role makes the spokesman sit in the top-level management. A spokesperson's function is far wider because he must be able to convince, harmonize, explain, and personify leadership from an organization or corporation to the public or stakeholders.

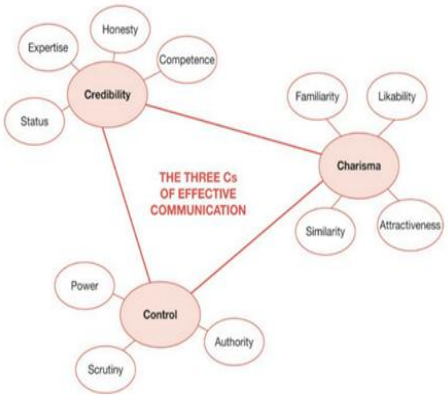
The development of 24 24-hour news model and what will grow in the social media as a means of sharing news and information to create situation, in addition to continuously providing information, is also expected to constantly give a review of news on current issues. In the digital era, news spreads very fast, frequently without being checked against the fact and consequently, the public accept it in an emotional and reactive way. The action is very important to prevent the spread of wrong and dangerous information, thereby enabling the organization to spread honest and factual information.

Leadership and crisis team must gather as accurate information as possible that will help and inform the next step in order to achieve the final goal. In the course of this crisis, the leadership and crisis team must have a well-defined ideal goal and remember it when they make a decision on how to respond and to whom a message is conveyed. This technological and industrial revolution will increasingly accelerate and effectively expand the application of Artificial Intelligence (AI).

In the complex information pattern and information that comes in various forms disseminated quickly through various networks (Dong et.al. 2018; Pourebrahim et al. 2019; Liu et al. 2020) in Toni, as well as in the context of political crisis, the computation method can gain a new outlook about how different actors communicate about political scandal and how the phenomenon is framed or defined in a communication process (Shah et al. 2002).

Theoretical Frameworks

According to Ronald D Smith, spokesperson is an important part of public relations team of an organization. Spokesperson plays a role in building and maintaining reputation, conveying key messages, handling crisis, establishing relations with the media, and representing organization in a public event. To become an effective spokesperson, in addition to having a very good communication skill, one must have integrity and ethics that are an unbargainable requirement. Spokesperson's credibility does not merely rely on skill, honesty and charisma but also needs deep understanding of his industry' complexity, situation context and atmosphere surrounding him.



Picture 1. Three Cs of Communication

Before making a public statement, a spokesperson must gather and analyze all pieces of relevant information to help him assess risks, identify main stakeholders and understand public sentiment. Hence, the spokesperson can manage a crisis, involve stakeholders effectively, and maintain credibility in a fast-moving media landscape. A strategic planning approach at least prepares a spokesperson to face uncertainty by preparing a clear and gradual response plan, ensuring consistency in conveying messages on various platforms, and helping mitigate crises effectively rather than merely giving reactive responses.

To increase the credibility of and trust in the spokesperson, make sure that communication is conducted in an open, transparent, and accountable manner. Hence, this will create a proactive communication pattern. Smith emphasized that reputation has a direct and predictable impact. Reputation enables a spokesperson to influence the public effectively. "Demand" to become a credible and effective spokesperson needs three Cs. According to Smith, they are Credibility, Charisma, and Control. Credibility is power and foundation to inspire audience (power to inspire). Credibility is one of the strongest assets and is not merely a trusted figure.

Credibility is power to inspire trust itself. Credibility influences audience effectively. Spokesperson with strong credibility has power to persuade, lead and encourage a significant change in relation to the public. Charisma is personal charm that makes spokesperson acceptable more easily and serves as a key factor to influence the public's perception, emotion and trust. By combining likeability, similarity, familiarity and attractiveness, spokesperson can develop more comfortable conversation. Control, is power of command, to influence and direct communication. Control is very important to manage the public's perception, credibility and crisis communication. By knowing power dynamics, public watch, media attention, and authority, spokesperson can increase his influence.

A spokesperson with high power will have an impact on low supervision, and strong authority has a bigger control over their message. On the contrary, spokespersons with low authority will have high supervision. Weak authority will find it hard to influence narratives effectively. A study conducted by Minnesota State University in 2004 shows that the spokesperson's role becomes more important during a crisis, particularly for large, complex organizations such as the Centres for Disease Control and Prevention (CDC) in the United States. CDC failed to prepare the main spokespersons capable of handling the anthrax crisis effectively. It turned out that various kinds of fragmented

information from different sources claiming to be affiliated with the CDC contributed to situational ambiguity, leading to increasingly worsening efforts to handle anthrax.

The best quality and most consistent information came from cooperation among all involved institutions (Osterholm & Schwatz, 2000). By involving stakeholders of the organization in coordinating multi-institutional communication, the crisis could be resolved more quickly and a crucial communication channel could be made, thereby resulting in a better understanding between the organization and its stakeholders (Seeger, Sellnow & Ulmer, 2001). Indeed, the role of spokespersons in the digital era faces a serious problem, particularly in role transformations, challenges faced, and opportunities expected. In December 2024, Nadiia Bilan and his two partners in their scientific article titled *A Spokesperson in Digital Age: Transformations, Challenges and Opportunities*, explored the spokesperson's role that continues to develop.

Spokesperson's role continues to transform along with the need to interact personally with the public, how to manage modern digital platforms, ensure message consistency, and adapt to new formats and the speed of news dissemination. Digital transformation has significantly changed the spokesperson's communication role. Communication currently takes place on real time and instantaneously. Digital news reporting offers maximum novelty through social media. News reporting continues nonstop, 24 hours a day, and seven days a week, with breaking news. Right now, spokespersons must respond to the crisis quickly and answer the public's and media's questions instantly. Digital platforms such as Twitter, Facebook, and LinkedIn surely need a short, concise, fast, and strategic message format. Transformation regarding the existence of spokespersons is also related to the public's direct involvement.

Unlike in the past, today the public can directly interact, along with the presence of a live news program (live session). These all strengthen instant involvement. Nowadays, not only journalists but also spokespersons are directly watched by the audience online (Chadwick, 2017). The public's scepticism about corporate and government spokespersons has increased due to the past scandals and wrong information exposure (Bennett & Livingston, 2018). Digital activism and culture have created a new risk in which past statements and actions can reemerge and damage credibility (Giglietto, Iannelli, Rossi & Valeriani, 2020).

Spokespersons must ensure that messages are conveyed consistently based on facts and in line with corporate and organizational values. In the digital space, any statement is recorded permanently and can be watched or read again anytime. Any inconsistencies in messages will immediately be disclosed by journalists, activists, and the general public. Spokespersons in the digital age frequently face a crisis due to a controversy that goes viral. Therefore, an understanding of the concept and theory will help spokespersons respond to it effectively. Intellectuality helps increase a spokesperson's bargaining position in controlling a crisis.

Timothy Coombs offered a theory that can help spokespersons control a situational crisis, namely Situational Crisis Communication Theory (SCCT). This theory explains how an organization and spokesperson must respond to a crisis based on the level of threat to reputation. SCCT helps understand an effective communication strategy to ease up a crisis as well as to build second credibility of both the spokesperson and organization. Through an SCCT approach, a spokesperson can decide whether the organization must use the strategy of denying, diminishing, rebuilding, or bolstering (Coombs, 2007).

The former Director and Country Head of Corporate Affairs of Citibank disclosed that complexity and uncertainty about the current globalization have made the spokesperson's position increasingly important, while at the same time, it is complicated. It is important because the post of spokesperson in the government's or corporation's activities apparently begins to become part of the top management circle; however, it undergoes complexity in terms of structure and authority. The existing complexity makes the spokesperson's role and function different and ungeneralizable, depending on industry, organization, and the clarity of the spokesperson's role.

Despite the acknowledgment of the spokesperson's role, its legitimacy has not ideally been achieved. "There are many spokespersons today, for instance, in the government sector. There has not been clarity on their firm's role and structure as a whole. This makes the accuracy and credibility of information less trustworthy," said Agung while describing his own experience in sensitive, complex, and competitive industrial sectors, namely the banking and mining industries. To that end, efforts to increase spokespersons' capacity and competency are badly needed.

According to Agung Laksamana, there are at least five skills that spokespersons have, namely public communication, information selection and categorization, proportional communication openness, good relations, and negotiation skills.

Additionally, different transparency dimensions (integrity, respect, and openness) of spokespersons encourage different perceptions of spokesperson's credibility that it will help explain the different performance and perception of the organization or corporation itself. Especially when public communication is concerned, Agung Laksamana stressed that there is one approach that may serve as guidance for spokespersons to carry out their role, namely rhetorical tradition inspired by Aristoteles nearly 25 centuries ago. Aristoteles in "Rhetoric", identified three central elements that lay the foundation for persuasive communication up till now, namely Ethos, Pathos, dan Logos.

Material and Methodology

This research uses a qualitative approach, which is a research procedure to produce descriptive data in the form of oral and verbal sentences from the object to be researched. Through a qualitative approach, this research uses or finds a complete picture of the object to interpret the existing reality that will be studied as a whole. The characteristics of this research align with its objective as well as descriptive research to expect and give a complete understanding of this topic.

From the result of monitoring the selection of words used to convey messages, the research finds that it may create controversy. By focusing on the use of language to determine controversial words in the language, research is conducted to understand more broadly and deeply the content of the language used. The use of the language that tends to be active will influence all sides, both Zulkifli Hasan and other parties, including spokesperson Hasan Nasbi.

Results and Discussion

The result of this research is about the reporting of the free nutritious meal (MBG) program based on the statement of Coordinating Minister for Food Affairs Zulkifli Hasan carried in www.tempo.com. In the news stories about the issue, several information are conveyed use mass media. The language used several sentences with linguistic style and the content of language that already exists or will harm parties. This condition is complicated enough and will cause several particular factors within the government, as well as public officials/officers. And anything that individuals who already have authority, like public officials/officers in the media, will have influence to shape and create the opinions and thoughts of the public who hear or read it.

There is a fact, information, or news about it in the wider community that Zulkifli Hasan, or the food affairs minister, is an official. Having been involved in politics since around 2005, Zulkifli Hasan is a politician in Indonesia with a wide range of experience in politics. He began to gain popularity and join a political party around 1998. He was elected a member of the House of Representatives around 1999. Since then, his political career has continued to shine. In 2005, he was elected House Speaker, which can influence the wider community.

This information can spark a controversy and has a lot of potential in the community to influence public opinion due to the presence of players in the community. The public will easily accept information in the mass media without checking its truth.

In this research, the presence of this site that the mass media will publish also plays a role and takes responsibility for applying it in several regulations to support positive content and educate the public. Hence, the consequence of the language used in impropriate content can be avoided.

Therefore, to be able to handle the issue of implementing journalistic ethics among various parties sending it, there is a need to stress several aspects, which are: (1) honesty; (2) integrity to inspire materials in online media. Apart from that, it is necessary to strengthen awareness of life philosophy in the community to be able to receive knowledge using online media to accept it as it is.

The norms prevailing in online media can be applied as properly as possible in the community by operating on the target. One of them is that the media is able to have a good impact on the community. However, in daily life, many reviews from the public make use of online media and operate it for bad purpose in public opinion or even publish bad information. This is the freedom of conveying information in online media.

In this aspect, improving capability in online media among the critical community will be the most important part to reduce the bad impact of news stories that the public advertises in social

networks. In the community, there is the capability to appraise published information that can be seen in online media to classify facts and opinions in the public, and identify efforts to manipulate news.

Spokesman Hasan Hasbi can also describe it from the social and moral perspective in which spokespersons take moral responsibility for what they communicate. The meaning of spokesperson covers moral and ethical issues related to right, obligation, responsibility, and ability as well as attitude related to fact while speaking. The cause and effect of this concrete consequence is that the public can observe and debate the level of the spokesperson's responsibility.

A spokesman for an institution that conveys a level of responsibility for the meaning and purpose of the speaker can control it through various meanings that increase or lower the level of responsibility for the meaning of certain language. In practice, not speaking is considered one of the controversial speakers.

Conclusion

The digital age, want it or not, like it or not, has changed the role of spokespersons that make their responsibilities more dynamic and faster, and create relations with the wider community. Despite stigma and bias inherent to the role of spokespersons, spokespersons face a common challenge to face the emergence of misinformation, disinformation, and hoaxes, a tighter spotlight and watch from the public, and media decentralization.

Spokespersons also have new opportunities to get involved directly with the audience, send messages or narratives through chat, as well as build global influence. To make the role of spokespersons more successful and effective, they must apply transparency, dexterity, and digital literacy, ensure that they navigate controversy effectively, and build long-term credibility in the interconnected world (interconnectedness). Digital news platforms that operate 24 hours a day put pressure and increase stress on spokespersons because they must always be on standby to respond to any crisis quickly and accurately. The ability to manage media and the presence of decentralized influencers pose a special challenge for spokespersons. In the past, journalists used to be a medium. Today, it is independent bloggers, influencers, and citizen journalists who play a significant role in shaping public perception because they have more trust than conventional media.

In using language in the digital age, spokespersons or public officials are required to balance their identity and profession. The public easily monitors or watches the personal online media accounts of spokespersons. Also, the public immediately relates the personal opinion or controversial opinion of spokespersons in the past to their current professional role. So, the challenge is how spokespersons safeguard their originality while at the same time ensuring that their personal belief do not contradict their professional responsibilities.

Despite these challenges, the digital age offers unprecedented opportunities for spokespersons. Digital platforms facilitate global reach and direct, unmediated engagement with audiences, enabling the rapid dissemination of key messages and fostering cross-border dialogue. Furthermore, digital tools can enhance message targeting, personalize communication, and leverage multimedia storytelling to build a stronger emotional connection with the audience.

After transformation and challenge, the digital age also opens new opportunities and ways for spokespersons to make their communication role and activity more effective. Several main opportunities include expanding global reach and influence, in which a digital platform makes it possible for spokespersons to interact with a global audience easily and instantly.

Integrate ethical Digital Literacy. Spokespersons should undergo continuous training to master both digital tools and ethical decision-making in online spaces.

Balance Authenticity with Institutional Responsibility. The organization should establish clear guidelines for personal-professional boundaries in spokesperson communication while allowing space for human connection.

Adopt Proactive Engagement Strategies. Rather than responding reactively, spokespersons should employ anticipatory communication frameworks to address potential crisis before they escalate.

Leverage Data-Driven Insight. Use audience analytics and sentiment tracking to adapt messages dynamically and align with public expectations.

References

Barrett, D.J. (2014). *Leadership Communication.* McGraw-Hill Education

Bennett, L & Livingston, S. (2018). The Disinformation Order: Disruptive Communication and the Decline of Democratic Institutions. *European Journal of Communication, 33*(2), 122-139. *DOI:10.1177/0267323118760317*

Bilan, N., Korneev, V & Netreba, M. (2024). A Spokesperson in Digital Age: Transformation, Challenges and Opportunities. *Integrated Communications, 18*(2), 107-115. DOI:10.28925/2524-2644.2024.1814

Coombs, T.W. (2019*). Ongoing Crisis Communication: Planning, Managing, and Responding*. SAGE Publications.

Cornelissen, J. (2020). *Corporate Communication: A Guide to Theory and Practice*. SAGE Publications.

Debunking Handbook. (2020). *Countering Misinformation: New Handbook Summarize Latest Research into Countering Misinformataion*. University of Maryland. https://education.umd.edu/news/10-14-20-debunking-handbook-2020-countering misinformation

Fallis, D. (2015). What is Disinformation? *Journal Library Trends, 63*(3). 401-426. https://doi.org/10.1353/lib.2015.0014

Hamad, I. (2017). *Komunikasi Strategis: Mengelola Isu, Merek, dan Reputasi*. Bumi Aksara.

Hallahan, K., Holtzhausen, D., van Ruler, B., Verčič, D., & Sriramesh, K. (2007). Defining Strategic Communication. *International Journal of Strategic Communication*, *1*(1), 3–35. https://doi.org/10.1080/15531180701285244

Krisdinanto, N., Apul, M.M.B., Ritonga, R. (2024). Critical Moment for Indonesian Journalism: Disappearance of Journalistic Firewall. *Jurnal Komunikasi: Malaysian Journal of Communication*. *40*(2), 92-110. https://doi.org/10.17576/JKMJC-2024-4002-06

Kovach, M. (2020). Leader Influence: A Research Review of French & Raven's (1959) Power Dynamics. *The Journal of Values-Based Leadership*. *13*(2). DOI: https://doi.org/10.22543/0733.132.1312

Smith, R.D. (2021). *Strategic Planning for Public Relation*. Routledge

Sellnow, T. L., Seeger, M. W., & Ulmer, R. R. (2002). Communication of Crisis: A Review of the Literature. *Journal of Communication Management, 7*(4), 358-367.

Wardle, C., Derakhshan, H. (2017). *Information Disorder: Toward An Interdisciplinary Framework for Research and Policy Making*. Council of Europe Report. https://rm.coe.int/information-disorder-toward-an-interdisciplinary-framework-for-researc/168076277c

Zhang, C & Lu, Y. (2021) Study on artificial intelligence: The state of the art and future prospects, *Journal of Industrial Information Integration*, 23, September 2021, 100224 https://doi.org/10.1016/j.jii.2021.100224