**Image Analytics in Marketing – Reply Notes**

Dear Christian, Martin, and Arnd,

Thank you very much for the thoughtful reviews. We have made a great effort to go over the comments and address them.

*A focal suggestion that both Reviewers make relates to providing novice readers a “sense where to start” (Reviewer 2). Reviewer 1 suggests to include a short data example and offers some ideas in this regard. Reviewer 2 suggests to provide some more technical details and offers some guidance in this regard. Overall, we see value in the Reviewers’ ideas and would like to encourage you to consider their suggestions. Please note that we do not have space limitations; addressing the reviewers’ comments does not imply that you need to change the current chapter. In addition, we also agree with Reviewer 2 that there “need to explain [the technicalities] in tremendous depth”; for specific aspects you can offer focal references which will be of great value for readers. From the prior German version of the Handbook, we know that chapters that contain practical examples have a much higher chance to be used (and cited). Ideally, you could provide a (fictitious) dataset which our readers can use to replicate your analysis (if you upload the dataset to the Meteor submission site, Springer can make the data available to our readers). Since the field is evolving, as you write, and to not disturb the flow of the chapter, you could add the data example as an Appendix (which will also appear in print).*

We followed the comments and added to chapter a tutorial with examples for the implementation of key methods in image analytics: several types of feature extraction, tagging, and a convolutional Neural Network (CNN) classifier. We added additional explanations in the chapter. This was a massive effort that went beyond the initial scope we planned for the chapter, but we realize its importance and hope it will be a gateway for the rookie image analytic marketing researcher. We attach the pdf version of the tutorial to this revision. The tutorial is available on https://github.com/dariasil/image\_tutorial.

*The reviewers provide some additional suggestions on how to improve the chapter further. We strongly encourage you to consider the reviewers’ comments.*

*In addition, Springer provided you with formal changes that are necessary (and which we cannot influence). We therefore would like to ask you to perform those changes as well (please also find them attached to this letter). In addition, since Springer does not do much copy-editing, we summarize typos and smaller classification questions here:*

Thank you for the careful reading. We implemented all the changes.

*• Page 3: tagging methods, tag-based classifiers (not clear)*

Done.

*• Page 5: Title 2.1.2 “towards” written twice*

Done.

*• Page 11: What is the ImageNet dataset that you refer to?*

Done.

*• Page 24: “in marketing that fall into this quadrat are have a rich”*

Done.

*Finally, Springer typically asks authors to cross-reference other handbook chapters. To support you in this regard, you may cross-reference the following chapters (please find attached):*

*• Humprehys, A. (2021), “Automated Text Analysis”*

*• Reutterer, T. and Dan, D. (2021), “Cluster Analysis in Marketing Research” (chapter 4.2)*

*• Feit, E. and Bradlow, E. (2021), “Fusion Modeling” (page 3: merging datasets; however, does not necessarily fit with your message)*

Done.

*Once again, we want to thank you very much for your article! We are looking forward to see the revised version published soon.*

Thank you for having us on board for this book.

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**Rev 1: Image Analytics in Marketing – Friendly Review**

*The book chapter “Image Analytics in Marketing” provides a conceptual and methodological overview of research questions and approaches related to (advanced) image analytics. No doubt, image analytics is a rapidly growing field and is likely to play an increasingly important role in marketing in the coming years. I want to commend the authors on an excellent introduction to this timely topic. Specifically, the book chapter has the following strengths:*

*• Intuitive frameworks helping researchers and practitioners in tackling questions related to image analytics, e.g., Figures 1 and 6 as well as the overall structure of the book chapter,*

*• Broad overview of specific, current research questions in Chapter 2,*

*• Deep methodological expertise and knowledge of recent (marketing) publications related to image analytics.*

*Consequently, I consider this book chapter a very valuable resource that I would recommend to any of the four target groups of the “Handbook of Market Research”.*

Thank you for the positive feedback and the constructive comments.

*Given the high quality of the authors’ work, in what follows, I would like to offer only minor suggestions to further strengthen the contribution of the book chapter. I hope the authors find the following comments helpful, which are listed in decreasing priority:*

*1. Considering the overall objective of the handbook (i.e., “help readers to apply advanced market research methods” and “facilitate the use for novice users of the method(s)”, see reviewer guidelines), I would encourage the authors to include a simple empirical application in their book chapter that can help readers jump-start their own image analytics projects. Potential ideas could be: (a) embedding three images in lower-dimensional space and computing pairwise cosine similarities to illustrate what is conceptually already explained in the book chapter, (b) extracting hand-crafted features from an image, e.g., using the OpenCV library in Python, or (c) fine-tuning a pre-trained convolutional neural network with small-scale training data in a supervised manner using a publicly available dataset. The code could be made available via GitHub and executed on cloud-based services like Google Colab or Paperspace (both offering free instances).*

Thank you for the comment. We followed your guidance and created a software tutorial which implements fundamental image analytics tasks and can be used as a gateway to the novice reader. Specifically, we demonstrate how to: a) extracting low level features such as color and shape, b) extracting interpretable features – tagging, c) fine tuning pre-trained convolutional network classifier.

The tutorial is attached and is available on https://github.com/dariasil/image\_tutorial.

*2. The introduction refers to “television advertising” to underscore the importance of visual content. The link between images and videos (i.e., moving images consisting of a sequence of frames) could be made clearer. This could at the same time expand the impact of the book chapter as video content is a natural extension of image analytics and similar methods can be used, especially as the book chapter already mentions video content several times (e.g., in chapter 2.2.1). The authors might find the following two recent sources helpful:*

*a. https://www.sciencedirect.com/science/article/abs/pii/S0167811619300217*

*b. https://www.sciencedirect.com/science/article/pii/S0148296320306445*

Thank you for the comment. We expanded the explanation on the connection of image and videos, we also included the sources you mentioned.

*3. In chapter 4, the authors could add a paragraph on error analysis, i.e., exploring errors in a so called eyeball dev (or validation) set. The free ebook by Andrew Ng provides illustrative explanations for the insights from error analysis that can be helpful to improve model performance, e.g., by selectively improving training data quality depending on the results from the error analysis. (https://www.deeplearning.ai/machine-learning-yearning/).*

Thank you for the comment. We looked at the error analysis explanation provided in the book, but decided not to include it in this chapter.

*4. To underscore the importance of images (vs. texts), the authors could consider including the Li & Xie (2020) paper already in the introduction, which finds: “a significant and robust positive mere presence effect of image content on user engagement in both product categories on Twitter.“ (*[*https://journals.sagepub.com/doi/10.1177/0022243719881113*](https://journals.sagepub.com/doi/10.1177/0022243719881113)*)*

Thank you for the comment. We now cite Li & Xie (2020) also in the context of the importance of images over text.

*5. In chapter 4.1, a brief explanation of convolutional neural networks (CNN) as the most important class of deep NN for image analytics could be beneficial. In this context, the authors could briefly mention ResNet and VGG16 as typical CNN architectures so that readers unfamiliar with these can follow more easily on the subsequent pages. A reference to the most recent experiments using Transformers for image analytics could be made, but is clearly optional (e.g., https://ai.googleblog.com/2020/12/transformers-for-image-recognition-at.html). I very much like the link the authors establish between text and image analytics (e.g., bag-of-tags approach).*

Thank you. We added an explanation of convolutional neural networks, and mention ResNet and VGG16. We cited the transformers resource you mentioned, but we did refer to it in since it requires further explanations that shift the scope from the marketing context.

*6. In chapter 2.1.2, where the authors talk about quantifying the value of designs, Burnap et al. (2019) might be an inspiring recent working paper that could be of interest to readers (https://arxiv.org/abs/1907.07786). Although only remotely related to the kind of image analytics described in the book chapter so far, the authors could consider mentioning the application of GANs for visual marketing applications (e.g., in their discussion) or in the context of Burnap et al. (2019).*

Thank you. Following your comment, we added the Burnap et al. (2019) to 2.1.2,we also described the application of GANs. Thanks for drawing our attention to it.

*7. I agree strategic brand collaborations are an interesting application of image analytics techniques (chapter 2.3.3). The authors could mention that co-occurrences of brands are not only relevant for product design decisions, but also when tracking visual brand presence in social media (e.g., understanding which vodka brands Red Bull appears with).*

Thank you, we followed your comment and relate to the co-occurrence in social media.

*8. In chapter 2, the authors could consider including the quantification of sponsorship ROI using visual techniques.*

Thank you. This seemed to us as a bit out of scope, so for the sake of brevity we decided not to include this.

*9. The beginning of chapter 3 mentions the ImageNet dataset. Adding a reference would be helpful to guide interested readers.*

Thank you. We added the reference.

*To conclude, I want to commend the authors again on an excellent book chapter that I believe has potential to inspire and help many researchers and practitioners with varying levels of expertise to pursue a project related to image analytics. I wish the authors all the best.*

Thank you. We appreciate your thoughtful reading and the constructive comments! Thanks for taking the time to read the chapter and help make it better.

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**Rev 2: Image Analytics in Marketing – Friendly Review**

*My congratulations to the authors on writing such a comprehensive review of this growing and constantly changing field. Given so much of the work in this space is still in progress, it must have been no easy feat to synthesize all of this and produce such a well-written chapter. I will keep my review fairly short, as I think there is only really one major area that, in my opinion, could be improved, along with a few smaller changes.*

Thank you for your support and for the constructive comments, we followed your guidance and implemented them, we hope you find the revised version satisfactory.

*The one thing I feel is missing in this chapter is any amount of technical detail. My sense is that the authors have done an excellent job at presenting these ideas intuitively. But, if I had no technical background in image analytics except having read this chapter, I feel I would still have no real sense where to start, or how any of the algorithms describe work “under the hood.” In this sense, I feel the paper is well-targeted toward a totally non-technical audience, and perhaps marketing academics who are not interested in working in the field, but not well-suited for a masters or Ph.D. student interested in getting his or her feet wet in the subject, or for methodologically ambitious practitioners. I think Section 4 could be easily modified to include more details. For instance, the idea of pixels and the raster array could be introduced with more detail, with an eye toward explaining how images can literally be used as data. Similarly, while there’s lots of discussion of, e.g., different features that can be extracted, one might wonder how you actually go about doing that. Libraries like python’s scikit-image could be mentioned.*

Thank you. Indeed, defining the target audience and deciding on the right balance between too technical to too general, is a challenge. Since the field is rapidly evolving, we did not want to provide too many technical details, which will make the chapter irrelevant when the field advances with new software libraries and datasets. Therefore, to follow your advice and provide a gateway for the starting image analytic researcher, we added a technical tutorial to the chapter. The tutorial, which is attached in a PDF format and is available on https://github.com/dariasil/image\_tutorial, contains implementations of several fundamental image analytics tasks: color and shape feature extraction, tagging, and a fine-tuning pre-trained convolutional neural network classifier.

*Similar, in the discussion of deep learning, I think the current discussion could be built upon to detail, for instance, how convolutional neural networks (CNNs) work, as they are the backbone on which most image processing nets function. This intuition could be connected back to the previous intuition, and libraries for implementing these things could be described (PyTorch, Tensorflow). Of course, I don’t think the authors need to explain this in tremendous depth; there are plenty of tutorials out there. But, as I said above, I’d still like to have more guidance on the actual practice of going and implementing some of these ideas, ideally from scratch, with an intuition of how images actually work as data.*

Thank you. We added a paragraph describing convolutional neural networks, and included an example in the tutorial.

*Besides this more “major” suggestion, I have a few other suggestions which I think could benefit this (already very good) chapter:*

*• I’m surprised there is no discussion of generative models for images, particularly given the widespread popularity of models like GANs and VAEs, that have also recently been adopted by some marketing papers. I think there should be some mention of these methods, perhaps when discussing unsupervised methods. They are among the state-of-the-art, and of a different type than the supervised methods discussed more at length.*

Thank you. We followed your advice and cite relevant papers using generative models marketing.

• *I think perhaps a table or a section describing some of the machine learning terms and databases could be useful, as that may be a key barrier to a marketing practitioner entering this space. For instance, you mention things like ImageNet, ResNet, VGG16, etc. These could be elucidated more directly, perhaps along with other common ML databases like MNIST, CIFAR, CelebA which readers will almost certainly encounter when reading about the topic, and perhaps with some references to the original CS papers.*

Thank you. Following your comment we added a dictionary to the tutorial, describing basic terms and mentioning, among other things, some of the existing databases.

*• There are a few relevant citations missing throughout Section 2. In particular:*

*o In Section 2.1 about design, Alex Burnap and John Hauser have a few (working) papers dealing exactly with some of the topics mentioned, like characterizing designs and quantifying designs (e.g.,* [*https://arxiv.org/abs/1812.11067*](https://arxiv.org/abs/1812.11067)*, https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3421771). Remi Daviet also has a marketing paper that’s particularly relevant herein:* [*http://remidaviet.com/jmp.php*](http://remidaviet.com/jmp.php)*)*

Done. We added these citations.

*o In Section 2.3, logos are part of brand imagery in relation to brand hierarchy, and as shown in Figure 2, but the Dew, Ansari, and Toubia reference that is mentioned elsewhere isn’t mentioned in this section.*

Done. We added the reference of Dew Ansari and Toubia to that section.

*• In Section 2.3 more generally, I think a conceptual distinction should be made between visual brand identity in the minds of consumers, as elucidated by the Dzyabura and Peres (2020) paper, and visual brand identity in terms of design, as studied in, e.g., the Dew et al. paper. In the former, images are used to understand consumer perceptions. In the latter, the focus is on the actual designs produced by the firm.*

Done. We changed the terms to “brand perception” and “brand visual elements.“

*• The introduction, especially on page two, reads a little awkwardly, particularly the transition between the paragraph ending in “Finally, upward looking angles…” and the paragraph starting with “The propensity of consumers…” and then also the next paragraph. I wonder if perhaps some of the citations could be deferred to their own section having to do with behavioral research on how consumers perceive images, or visual effects in behavioral marketing, such that the introduction could serve as more of a simple overview of the relevance of the topic for modern marketing.*

We changed the working of the subsequent paragraph, to improve the flow of the introduction.

*In sum, I think it’s a great article. I think with a bit of added detail, it will certainly make an excellent reference for all marketing scholars interested in the field of visual analytics, and I look forward to reading (and recommending) the final version.*

Thank you! And thank you for the constructive comments. We truly think they made the paper better.

***a) Are the statements about the method(s) accurate and correct? Do they represent the current level of knowledge in the field?***

*Yes, it is a very well done literature review, and summary of the field as it stands within marketing. It is also a decent summary of the state of the art in computer science, as it has been applied in marketing, with the somewhat glaring omission of discussion of generative models like GANs and VAEs. I think generative models like these represent an important part of the state-of-the-art in CS, are being used more and more in marketing, and should be discussed.*

Thank you. We reference now relevant papers in marketing using GANs. Indeed, they are part of the tools and should be mentioned.

***b) Does the paper give an intuitive account of the method that will facilitate the use for novice users of the method(s)?***

*The paper is very intuitive, but perhaps too intuitive, as it does not give much detail for someone looking to actually start using these methods.*

To improve the intuition-technicality balance, we added the tutorial. We hope it provides the technical detailed without harming the readability of the chapter.

***c) Is the technical material sufficient to allow for an advanced understanding of the method(s) described?***

*No, there is very little technical material.*

Now there is ☺.

***d) Is the paper clear in its writing? Is the formal material helpful and clear?***

*Yes, the paper is written very clearly.*

Thank you.

***e) Does the paper sufficiently demonstrate the application of the method(s) described?***

*The paper includes many examples, and a wonderful framework for thinking about research in this field. But, as mentioned, it gives very little technical details, and no examples of the how of actually doing these things.*

We hope the balance is better now.

***f) Is the article comprehensive in the sense that all major issues important for the implementation of the method(s) are covered?***

*At a high level, yes.*

We followed your advice and added the missing topics.

***g) Would you recommend the article to a colleague for his own research? If not, why not?***

*I would say the article makes an excellent literature review for a colleague looking for a reading list, as well as an excellent summary of important considerations to be aware of before diving into this field, but is not technical enough of an introduction for actually getting into things.*

***h) Would you recommend the article to a Ph.D. student for his own research? If not, why not?***

*Same as (g).*

***i) Would you recommend the article to a master student as introduction to the topic? If not, why not?***

*Yes.*

Thank you.