FACULTY OF PHYSICS
UNIVERSITY OF WARSAW

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Dissertation Review

Title of the dissertation: Scene–object interactions in naturalistic vision: insights from behavioural, neurostimulation, and computational studies

Author: Natalia Rutkowska, MSc

Institution: Nencki Institute of Experimental Biology, PAS

Reviewer: Jarosław Żygierewicz, PhD, DSc

1. Assessment of the PhD Candidate's General Knowledge in the Discipline

The dissertation demonstrates that the candidate possesses broad, deep, and up-to-date knowledge in the field of visual cognitive neuroscience. The introductory chapters provide a well-structured and comprehensive overview of naturalistic vision research, including classical findings, contemporary debates, and the methodological challenges inherent in studying real-world perception. The bibliography and literature citations used in the introduction and discussion reflect a broad, well-curated, and up-to-date selection of sources spanning behavioral vision science, cognitive neuroscience, neurostimulation, and computational modelling. The candidate draws on both foundational works (e.g., Biederman, Potter, Hubel & Wiesel) and contemporary research addressing naturalistic perception, scene and object processing, and deep neural networks. Citations are integrated thoughtfully, supporting the conceptual framing without overreliance on any single theoretical tradition. In the discussion, the literature is used not merely descriptively but critically, allowing the candidate to position her findings within ongoing debates about hierarchical versus bidirectional processing and the limitations of feedforward models. Overall, the referencing demonstrates strong command of the field and contributes to a coherent scientific narrative. The candidate not only understands the literature but synthesizes it effectively. The candidate also demonstrates awareness of broader conceptual issues, such as the ecological validity of experimental paradigms and the interpretational gap between artificial neural networks and human cognition.

Overall, the thesis reflects mature theoretical understanding, precise use of terminology, and the ability to situate the research within ongoing scientific discussions. The candidate's general knowledge in the discipline is fully adequate and appropriate for the doctoral level.

2. Assessment of the Candidate's Ability to Conduct Independent Scientific Research

Across the three empirical studies, the candidate demonstrates a high level of independence in designing, executing, and interpreting scientific research.

Study 1

The candidate independently designed two behavioral experiments addressing a long-standing question about the temporal dynamics of scene–object interactions. The methodological approach is sound, and the inclusion of balanced integrated score as a speed-accuracy measure shows methodological sophistication and awareness of potential confounds. However, the thesis would benefit from explicit clarification of whether the two experiments were conducted in a single session or across separate sessions.

Study 2

The TMS study is particularly demanding in terms of technical skill, safety procedures, and experimental control. I would like to note the scrupulous description of the procedure and appreciate the effort invested in stimulus creation and validation. The candidate demonstrates the ability to coordinate complex neurostimulation protocols, manage participant-specific parameters, and interpret chronometric TMS results.

While the methodological description of Study 2 is generally careful and thorough—particularly regarding stimulus preparation and the overall structure of the TMS procedures—several details require clearer reporting. First, one of the figures (Fig. 12 p. 61) lacks axis labels, which makes it difficult to interpret. Second, the fixed assignment of response keys (indoor = "f", outdoor = "j") raises the possibility of a systematic reaction time bias, especially given that all participants were right-handed; this issue appears both in the pilot phase and, as suggested by the text, in the main experiment as well. Third, although the thesis provides a rationale for assigning participants to either the OPA or LOC stimulation condition, the criteria and implementation of this individual selection would benefit from a more explicit explanation. These points do not undermine the overall high quality of the study and the candidate's demonstrated competence, but addressing them would strengthen the methodological transparency and reproducibility of the work.

Study 3

The candidate integrates behavioral research with computational modelling, applying a deep neural network to the same stimuli used in human experiments. This reflects the ability to work across methodological domains. The analysis involving the deep neural network in Study 3 raises some conceptual concerns that limit the strength of the conclusions. First, the network's accuracy values take only a few discrete levels (Fig. 21), under such conditions, the use of ANOVA becomes questionable. The study demonstrates that the network can be evaluated on object-only or neutral-background stimuli, it loses accuracy in the object-only condition, but it remains uncertain whether this tells us anything substantive about the computational mechanisms underlying human perception, as these types of stimuli were not used in the training of the network i.e., we don't know the accuracy of the network with the same architecture but tuned for the object-only stimuli. Also, the conclusion (p. 109): "Under phase scrambling, no significant differences were observed between human observers and a feedforward, scene-trained DNN; this parity indicates that low-level scene statistics alone are insufficient – in both architectures – to support object-based scene recognition." is too far-

reaching, unless the Author uses term *architecture* in somewhat non-standard way meaning the given trained instance of the network.

On the other hand, the human behavioral findings in Study 3 are clearly solid and convincingly presented. The patterns of performance across conditions are coherent, statistically well-supported, and align with established principles of scene and object processing. Overall, the human results provide a reliable foundation for the study's conclusions about the role of coherent scene structure in object-based facilitation.

Future Directions

Concerning section 3.2, I would encourage the candidate to carefully consider the balance between experimental control and ecological validity in future work. While the use of ambiguous or degraded stimuli has been productive for isolating specific processing mechanisms, continued escalation of stimulus ambiguity risks moving away from the naturalistic vision that provides the conceptual foundation for this research program.

Overall assessment

The candidate shows the ability to formulate clear research questions, competence in experimental design and data analysis, skill in integrating behavioral, neurostimulation, and computational methods, critical thinking in interpreting results, and the capacity to manage technically complex studies. The discussion of limitations is handled with clarity and intellectual honesty. The candidate not only identifies the methodological and conceptual constraints of each study, but also thoughtfully explains their implications for interpreting the findings. Rather than treating limitations as a formal requirement, the discussion integrates them into a broader reflection on what the results can—and cannot—tell us about real-world visual processing. This balanced approach strengthens the credibility of the work and demonstrates mature scientific reasoning.

Taken together, the dissertation provides strong evidence that the candidate is capable of independent, high-quality scientific research.

3. Assessment of Whether the Thesis Presents an Original Solution to a Scientific Problem

The dissertation addresses a central and unresolved question in visual neuroscience: How and when do scene and object pathways interact during naturalistic vision? The originality of the work is evident in several aspects:

Novel empirical contributions

Study 1 provides a systematic behavioral test of hierarchical vs. bidirectional models of scene–object interactions using two complementary paradigms. The finding that neither representation shows a temporal processing advantage, and that influences are mutual, challenges long-standing hierarchical accounts.

Study 2 offers the first causal evidence that object-selective cortex (LOC) contributes to the disambiguation of scenes. This is a significant and novel contribution, extending previous work that focused primarily on the reverse direction (scene-to-object influences via OPA).

Study 3 demonstrates that object-based facilitation of scene recognition depends on coherent scene layout, and compares this effect to a feedforward deep neural network. I have conceptual concerns about the DNN analysis, but acknowledge that the human behavioral findings are solid and that the study raises important questions about the limits of feedforward architectures.

Conceptual originality

The thesis argues convincingly that strict hierarchical models are insufficient to explain real-world perception, and that bidirectional, predictive-processing-like mechanisms better account for the observed data. This synthesis is theoretically meaningful and contributes to ongoing debates in the field.

Methodological originality

The integration of behavioral paradigms, chronometric TMS, and computational modelling within a single research program is itself innovative and demonstrates a multi-level approach to a complex scientific problem.

Overall assessment

The dissertation clearly presents original research, including novel empirical findings and a meaningful theoretical contribution to understanding scene–object interactions. It meets the criteria for originality expected of a doctoral thesis.

Final Evaluation

The dissertation demonstrates excellent knowledge of visual cognitive neuroscience, strong ability to conduct independent scientific research, and clear originality in addressing a significant scientific problem. The work is coherent, methodologically diverse, and contributes new insights to the field. Minor issues raised in the review concern reporting clarity rather than scientific substance. **The thesis meets the standards required by Act of 20 July 2018 – Law on Higher Education and Science (Journal of Laws 2024, item 1571, as amended) for the award of the PhD degree.**

Jarosław Żygierewicz

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Review of the doctoral thesis by Ms. Natalia Rutkowska, entitled "Scene–object interactions in naturalistic vision: insights from behavioural, neurostimulation, and computational studies"

Natalia Rutkowska's doctoral dissertation examines mutual relationships between perception/classification of visual scenes and objects. The PhD candidate utilized an experimental design in which an object appeared in a complex visual context, forming either congruent or incongruent scene, and the participants were tested with classifying scenes or objects. This series of three studies represents a model research program in contemporary cognitive neuroscience, consisting of a behavioral study, a neuroimaging study using time-locked TMS, and a study comparing the performance of human subjects with a machine visual scene classifier. The first study was a behavioral procedure with two response conditions: go-no-go and two-alternative forced choice (2AFC). Accuracy and reaction times were analyzed, as well as an integrated index of reaction times and response accuracy accounting for speed-accuracy trade-off. The results demonstrated the mutual influence of processing the visual representation of the object and the scene, with the incongruent items increasing both object and scene classification times. The second study used a similar task with a new sets of materials (object alone, scene alone, congruent/incongruent object-scene pairing), performed with transcranical magnetic stimulation (TMS), either four pulses in 100 ms intervals (Experiment 1, the full results of which are not analysed here) or a double pulse locked at different times from stimulus onset. TMS was located over the lateral-occipital complex (LOC), whose function in object recognition is one of the most well-studied neural basis of visual information processing or over the scene-selective occipital place area (OPA), or over a control area (vertex, Experiment 1 only) not involved in processing scene and visual object representations. Again, the aim of the experiment was to determine the role of scene processing in object identification and the processing of object representations in the scene identification process. The results were not fully conclusive, but they did confirm the role of LOC in scene disambiguation, although the timing of this process could not be precisely determined (which was one of the particular goals). The third study investigated whether object-facilitated scene recognition requires a coherent scene layout or can still occur when only low-level scene statistics are preserved. Both human participants and the Places365-GoogLeNet AI system classified scenes with objects placed on ambiguous scenes, phase-scrambled scenes, and neutral backgrounds. In both cases, performance demonstrated that a coherent layout is critical for object-based facilitation, and there were no significant differences in the accuracy of the human subjects and AI.

As I mentioned above, the topic of this dissertation is the interrelationship between object and scene recognition (classification). However, while the role of background (scene) congruence in object recognition has been extensively studied in various theoretical and methodological approaches, the role of object salience in scene classification is not yet well understood. However, both behavioral and neuroimaging studies indicate that processesing objects and scenes is implemented by different brain networks. At the same time, research also suggests functional connections between these processes. This, with particular emphasis on the previously poorly understood role of object representation in scene classification, was the main research problem of the doctoral candidate's own research. Such a formulation of the problem undoubtedly constitutes an important and original contribution to the area of science in which the thesis was placed.

Below I present my opinion on the individual sections of the dissertation.

Introduction. The first chapter—the theoretical introduction and definition of the research problem—is clearly written and contains a competent and representative literature review, consistently leading to the definition and justification of the author's own research problems. However, there is one thing that leaves me slightly unsatisfied. The work is presented as a dissertation, not a collection of articles. Although I consider a collection of articles to be a fully legitimate form of doctoral dissertation, in the current case the dissertation format could have a significant advantage—the three studies presented constitute a very consistently planned, sequential approach to solving a clearly defined problem, which is easier to demonstrate in a dissertation. However, the dissertation format also allows the candidate to demonstrate broad knowledge in their field of inquiry, extending beyond issues strictly related to the subject of their own research. This can be achieved by describing, even briefly, the broader context within which the more narrow research area develops, something that is usually not possible in a series of articles. In turn, this allows reviewers to confidently state that the work complies with one of the provisions of the art. 187 "Constitution for Science" Act (i.e. demonstrating the candidate's general theoretical knowledge in the discipline of the dissertation). The candidate made limited use of this opportunity, describing the theoretical context only to the extent and scope necessary to present her own research program (as is usually done in word-limited articles reporting research). Anyway, I have no reservations about reliability of the theoretical part and believe that the dissertation's introduction fulfills at least its basic functions. Therefore, the observation stated above does not affect my assessment of the work.

The entire empirical section of the dissertation was prepared with great care. All experiments were planned correctly, and the procedures and analyses are reported in a way that fully allows for potential replication. This is also crucial because the designs are complex, multifactorial, and complex measures are used. This, on the one hand, allows for addressing methodological and interpretative issues known from similar previous studies, but on the other hand, it can raise new questions (as I point out in some cases). It's also worth emphasizing that some of the reported studies (both experiments in the Study 2) were pre-registered.

Study 1. The experiments included in the Study 1 are well designed, conducted, reported and interpreted, and my comments are few and rather secondary. In particular, I have doubts about treating responses below 200 ms as incorrect in analyses. In my opinion, they should be treated as no responses, especially since in the analysis of response times such trials were not counted and, as a result (mostly in experiment 2, in which a response was required in every trial), the accuracy and

response time analyses are potentially based on different numbers of trials. Furthermore, the number of too early responses, as well as no responses, should be reported in the results (or in appendices). This also raises the question of whether there were outliers who had particularly high proportions of one of these response categories (I assume not, but such information, as well as information on the procedure for dealing with potential outliers, is important).

I have no objections to the use of the d' index in accuracy analyses instead of raw proportions, but since it is a composite indicator, data on the means/proportions of the individual response types should also be included in the results.

I believe that the use of bin analysis in the response time analyses was definitely the right decision and I see a number of arguments for using this method, but the dissertation lacks such justification. Also: the bin analysis is missing a crucial piece of information: the average time intervals for bins. This is important because it allows to assess whether individual bins may indicate different patterns of interaction, or rather just the level of activation of a given process.

The candidate created complex indicators of the distribution of responses accuracy, the purpose of which was to compensate for centrality/noncentrality problems in the empirical distributions, but did not undertake such measures in relation to RT, where some form of compensation for such problems (in this case, mainly skewness) is very common. I would like to emphasize that I do not believe the procedures used in the dissertation were flawed at all, but I am a bit disappointed with the lack of justification for the methodological decisions made in these analyses.

In the discussion of the Study 1, the candidate notes a strong trade-off between accuracy and response speed, and its interaction with the task (object or scene classification). However, she feels satisfied with the fact that the differences are leveled out after using the integrated indicator. Meanwhile, it's worth asking whether faster object classification at the expense of accuracy, and more reliable scene classification at the expense of time, doesn't say something significant about the direction of these processes.

Study 2. I have no serious reservations about Study 2, which used transcranical magnetic stimulation (TMS) over the LOC or OPA to attempt to assess the causal role of the scene recognition brain network in object recognition and the brain object recognition network in scene recognition processes (In fact, due to the emphasis on the role of object representation in scene classification, only the second part of the study is reported in detail in the dissertation). Of course, in a rather complex study in which the results of one section were used to assign participants to the experimental conditions of the other section, and it is always possible to debate whether specific decisions regarding the procedure or selected metrics and indices were optimal, but I see nothing in the overall procedure or the discussion of the results that could be decisively refuted.

Study 3. My assessment of Study 3 is a bit ambiguous. The experimental section, as in Studies 1 and 2, was designed and implemented completely correctly. The research hypothesis itself is of somewhat less theoretical importance in this case than in previous studies, but it does provide some further insight into the role of object representation in scene recognition. However, I have doubts about the validity of the section consisting of computer simulation and its comparison with the participants' results in the experimental section. Indeed, I believe that computer simulations are an

important part of contemporary cognitive (neuro)science and can contribute, in particular, to a better understanding of the cognitive and brain mechanisms of object and scene perception (as well as the development of more reliable artificial image recognition systems). But this function will only be realized if computer models implement the computational mechanisms that are postulated to explain cognitive/neural processes. The mere fact that an AI system trained to recognize natural scenes can/cannot recognize slightly degraded scenes with or without a non-degraded object similarly to human subjects adds little to our understanding of the computational mechanisms involved. Indeed, convolutional neural networks, by design, share some similarities with the organization of the human image recognition system, and perhaps this is why Places365-GoogLeNet performed similarly to humans, despite overall significant differences in computational architecture (one main data stream processed top-down), but the current study alone does not sufficiently support such a conclusion. Therefore, I would treat this part of the dissertation as a sort of exercise or a prelude to more conclusive research, rather than an actual solution to a scientific problem.

General discussion, Summary and Conclusions. Because the results and implications of each study are presented in considerable detail in their respective sections, the General Discussion is relatively concise. It consists of a summary of the results, an indication of their implications for further research, and a traditional section outlining the limitations of the study. Of course, with such a complex research project, there can be many points for discussion, and I hope such a lively discussion will take place during the doctoral defense, but I believe that what the candidate has included in this section of the dissertation is fully satisfactory.

Assessment of the formal side of the dissertation. I must emphasize that the entire dissertation has been prepared with great care from a formal perspective. The thesis was written in a clear manner. Its main part is preceded by a careful and detailed table of contents, informative abstract (in English and Polish), a list of abbreviations used along with their explanations. The sections reporting research contains informative tables and graphics facilitating the understanding of research procedures and the perception of results. The list of references is fairly extensive and well-selected, and representative of contemporary research. Finally, there is an appendix reporting the results of Experiment 1 of Study 2 (which was not analyzed in detail in the main text of the dissertation). The ability to correctly report research, although seemingly formal, is also one of the important elements of a researcher's workshop and documents the ability of the doctoral candidate to conduct research independently.

Conclusion of the review

The literature review presented in the dissertation, the description and justification of the methodological solutions used (despite the minor reservations I raised above), and the discussion of the obtained results in relation to previous work clearly demonstrate the general theoretical knowledge of the candidate for the doctoral degree in the field of cognitive neuroscience, particularly in the biological, psychological, and computational mechanisms of processing visual information about objects and scenes. The presented dissertation also undoubtedly provides an original solution to an important scientific problem. Third, although the conducted research cycle is the result of collaboration among many people, which is completely obvious in contemporary research in this field and which the candidate describes in her Acknowledgments, I have no doubt that Ms. Natalia Rutkowska's independent contribution is fully sufficient to conclude that she has

demonstrated the ability to independently conduct scientific work and, therefore, has met all three statutory requirements for the award of the doctoral degree (art. 187 pkt 1 i 2 Ustawy z dnia 20 lipca 2018 r. *Prawo o szkolnictwie wyższym i nauce;* Dz. U. 2018 poz. 1668 z późniejszymi zmianami). I therefore advise the Scientific Council of the Nencki Institute of Experimental Biology to allow Ms. Natalia Rutkowska to defend her doctoral dissertation, and, taking into account the importance and innovation of the research problems, the methodological advancement of the research conducted and the very high assessment of the formal aspect of the work, I request also to award the dissertation a distinction.

Żółwin, February 28, 2026.

Oświadczam, że **rozprawa doktorska mgr Natalii Rutkowskiej spełnia warunki określone w art. 187 pkt 1 i 2 Ustawy z dnia 20 lipca 2018 r. *Prawo o szkolnictwie wyższym i nauce;* Dz. U. 2024 poz. 1571 z późniejszymi zmianami. W związku z powyższym, wnioskuję do Rady Naukowej Instytutu Biologii Doświadczalnej PAN o dopuszczenie mgr Natalii Rutkowskiej do dalszych etapów postępowania w sprawie nadania stopnia doktora**. Rózwnocześnie, biorąc pod uwagę przedstawioną w powyższej opinii wysoką ocenę jakości i znaczenia dla nauki zrealizowaanych przez doktorantkę badań, a także jakość samej rozprawy, **występuję do Wysokiej Rady o wyróżnienie rozprawy**.

Żółwin, 28 lutego 2026.

Uniwersytet SWPS

Poznań, 15 April 2026

Dr hab. Jarosław Michałowski, prof. Uniwersytetu SWPS
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Review of the doctoral dissertation of Natalia Rutkowska, M.A.

entitled „Scene-object interactions in naturalistic vision: insights from behavioural, neurostimulation, and computational studies"

Supervisors: Dr. hab. Michał Bola, Prof. Marius Peelen

Research on scene-object interactions in naturalistic vision is a fundamental area of contemporary cognitive psychology and neuroscience. However, understanding how the human visual system processes real-world complexity with such remarkable speed remains challenging due to the dynamic interplay between global context and local details. Consequently, the precise mechanisms underlying this have remained subjects of intense debate. This debate draws on an interdisciplinary approach combining behavioral measures, neurostimulation, and computational modeling. These methods allow researchers to determine the causal necessity of specific brain regions and benchmark biological vision against computational models. In particular, chronometric transcranial magnetic stimulation (TMS) is a valuable tool for resolving the functional timing of these processes. In her Dissertation, Ms. Natalia Rutkowska addressed some critical gaps in naturalistic vision research. Using a series of thoroughly designed experiments, including behavioral tasks, chronometric TMS, and deep neural networks (DNNs), she investigated the temporal dynamics and causal pathways of scene-object influences. As a result, Ms. Rutkowska has prepared a complete doctoral thesis characterized by a high scientific level.

Formal evaluation

The doctoral thesis submitted by Ms. Natalia Rutkowska consists of three original experimental studies examining scene-object interactions in naturalistic vision, integrating

behavioral, neurostimulation, and computational methodologies to probe how the human visual system processes real-world stimuli. The thesis follows a classic academic structure, beginning with a theoretical introduction that presents significant definitions, theories and empirical evidences. This introduction is followed by presentation of the three studies, that are structured in a typical manner: specific research questions, research methods, results and discussion. The work concludes with a general discussion that summarizes the findings, discusses implications, addresses limitations and future directions. The dissertation is prepared with high scientific care and clarity, including a bibliography with 196 references reflecting mainly international scientific literature. Furthermore, the candidate provides clear abstracts in both English and Polish, a comprehensive list of abbreviations, and a record of her scientific publications.

Professional evalution

The theoretical part of the work consists of six subchapters, which constitute an adequate presentation of the most important issues related to the subject of the work: the development of the current research on naturalistic perception, neural mechanisms of scene and object perception, as well as theoretical assumptions and findings regarding the temporal dynamics of scene perception and scene-object interaction.

The entire theoretical part proves that the author is perfectly familiar with the current theoretical considerations and empirical basis on real-world scene perception and the relationships between scene and object processing as well as the nuances of behavioral and TMS research on this subject. In general, it is difficult to find any weaknesses that would disqualify this part of the work, as the whole work was prepared exhaustively and extremely carefully. At the same time, the text layout is logical and the narrative style is easy to follow. The literature presented in the introduction justifies undertaking the research problem defined by the author, and the presented argumentation allows for a full understanding of the choice of research procedures. Most of the research questions posed are justified by the empirical material, although the introductory part lacked the presentation of some more specific predictions (e.g. regarding the temporal characteristics of the object to scene interaction) and hypotheses, which gives the impression that the research conducted was exploratory in nature.

Introduction is followed by the presentation of the three experimental studies (and several pilot experiments) exploring the bidirectional relationship between scene context and object recognition, moving away from traditional hierarchical models that assume a fixed order of visual processing. Study 1 directly compared the processing speeds of scenes and objects using an orthogonal design to ensure that one dimension did not predict the other. By controlling for the speed-accuracy trade-off, the researcher found an absence of primacy for either scenes or objects. Instead, the results showed that their processing time courses converge, which aligns with predictive processing accounts of vision. Furthermore, an analysis of the response distributions revealed that interference from incongruent stimuli (such as a mismatched object in a scene) was nearly absent in the fastest responses and only emerged in the slower trials. This suggests that the interplay between scenes and objects occurs at later semantic or decisional stages rather than during the initial encoding of the image. In the discussion, the verification of individual hypotheses was addressed very effectively and systematically. Study 2 investigated whether the object-selective Lateral Occipital Complex (LOC) plays a causal role in recognizing scenes that are disambiguated by the objects within them. The results provided the first causal evidence that the LOC is selectively involved in scene recognition when facilitated by object information, as stimulating this area significantly reduced accuracy. Interestingly, stimulating the scene-selective Occipital Place Area (OPA) did not produce a similar impairment for this specific task, leading to the hypothesis that categorical indoor-outdoor judgments might rely more heavily on the Parahippocampal Place Area (PPA) or specific feedback connections between the LOC and PPA. The study suggests that the LOC likely processes spatial properties of objects, such as their size and position, to help the brain parse the overall scene layout. Study 3 examined whether this object-based facilitation depends on the preservation of a coherent global scene structure. By comparing performance across ambiguous, neutral, and phase-scrambled backgrounds, the researcher found that the benefit provided by the object disappeared when the scene's spatial layout was destroyed, even though low-level visual statistics like color and luminance were preserved. This indicates that object-based facilitation is layout-mediated, meaning the brain requires a structural framework to integrate object information effectively. A comparison with the Places365-GoogLeNet neural network showed that both human and artificial systems exploit object-based cues but remain sensitive to spatial layout. Collectively, these three studies demonstrate that real-world scene

perception is a dynamic process where scene and object representations interact at later stages of processing to resolve visual ambiguity.

The conducted research is noteworthy for its logical continuity and methodological rigor, demonstrating significant concern for participant well-being (e.g. the inclusion of frequent breaks) and the careful control of speed-accuracy trade-offs. The author further avoided potential priming effects by utilizing a between-group stimulus assignment. The laborious selection of stimuli and the identification of TMS stimulation sites are commendable, although the latter would have benefited from more technical detail . Particularly important in the context of attentional distortions, such as distraction by objects, was the successful equating of accuracy between scenes with and without objects . Furthermore, the effective use of figures and tables helps structure the results and allows the reader to follow the studies' internal logic.

These numerous advantages are accompanied by a few ambiguities. In Study 1, it is unclear whether objects were recognized faster because they appeared at or near the fixation cross, whereas scene assessment required a saccades. Also, while the author uses the d'index as a sensitivity measure, information is missing whether the data met the necessary assumptions for this specific calculation over other sensitivity measures. While the series of experiments used to prepare the stimulus set for Study 2 is impressive, more clarity is required regarding the performance results for the selected stimulus subset . As I understand it, the final set comprised 64 stimuli rated with the highest accuracy in the "scene-with-object" version . Since the general pilot study performance for the broader set was M=0.725, it would be advantageous to see specific data for the chosen subset, especially as accuracy in the main experiments was higher than this baseline. Additionally, a more systematic summary and discussion of the specific hypotheses regarding the temporal order of OPA and LOC contributions to scene recognition would be helpful. Using the same type of presentation as the one that was applied to illustrate predictions (Figure 12, pg. 61) at the end of the chapter would effectively summarize the findings. Regarding the third study, human performance in the "objects-only" condition appears to be above chance. The reader may expect an explanation for this. Furthermore, the author claims in the discussion that object-based facilitation was absent in the phase-scrambled (WOs) condition based on the lack of statistical

significance between WOs (0.643) and OO (0.619). However, both results remain above the theoretical chance level of 0.50, which also should be taken into consideration.
The dissertation would also benefit from a discussion regarding the disadvantages of using reaction time data as opposed to EEG or eye-tracking . Additionally, critical reflection on the fact that the scenes used in the studies lost their "natural" quality after such extensive digital manipulation is sparse, although the author rightly notes the necessity of studying perception within a broader context of multisensory, dynamic inputs. A deeper discussion is also missing regarding the role of object placement, stimulus size, and background color, especially in light of findings by Fize et al. (2011). Other issues that warrant deeper discussion include the cognitively demanding nature of the studies and the potential role of caffeine withdrawal among participants, particularly as caffeine abstinence was one of the inclusion criterion.

Finally, there are minor issues: the d' index and Signal Detection Theory require references, and more image examples would be beneficial. It is not always clear if practice stimuli were identical to some used as the experimental trials, such as in Study 3. Editorial errors include mixing study numbers (e.g., referring to Study 1 while introducing Study 2 just after a Study 1 chapter), the repeated numbering of subchapter 2.2.2.4.1.2, and inconsistent naming for stimulus categories, such as using both "isolated scenes" (IS) and "scenes with no object" (NO)

Conclusion

The responsibilities of a reviewer of a doctoral dissertation include determining whether the dissertation can be considered as an original solution of a scientific problem and whether the author of the dissertation has demonstrated sufficient theoretical knowledge within a given scientific discipline and a good ability to independently conduct scientific work. Both the theoretical and empirical part of the reviewed dissertation of mgr Natalia Rutkowska can be evaluated very positively. Regardless of my few critical comments above, the PhD student has proven that she has the research competences expected of people applying for a PhD. Therefore, I declare that **the doctoral dissertation submitted to me for a review meets the criteria specified in the Act of 20 July 2018 – Law on Higher Education and Science (Journal of Laws 2024, item 1571, as amended). Therefore, I am applying for the admission of M.A. Natalia Rutkowska to further stages of the doctoral proceedings.**