

[UNIVERSITY]
[SCHOOL]
[DEPARTMENT]

ODD Protocol

[Name]

[LOCATION]
[Date]

1 INTRODUCTION

1.1 HEADING 2

1.1.1 Heading 3

1.1.1.1 Heading 4

1.1.1.1.1 Heading 5

To enhance clarity, the **guiding questions** and corresponding answers are presented at the beginning of each section and are **color-coded** for ease of reference. A visual and summarized version of the protocol is provided in Figure 1.1.

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariat. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Grimm et al., 2020)!

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariat. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Grimm & Railsback, 2005)!

2 OVERVIEW (O)

2.1 PURPOSE AND PATTERNS

Lorem ipsum dolor sit amet, **consectetur adipisici** elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Me non paenitet nullum festiviorem excogitasse ad hoc. Ambitioni dedisse scripsisse iudicaretur. Unam incolunt Belgae, aliam Aquitani, tertiam. Morbi fringilla convallis sapien, *id pulvinar odio volutpat. A communi observantia non est recedendum* (Grimm et al., 2005).

2.2 ENTITIES, STATE VARIABLES, AND SCALES

Phasellus laoreet lorem vel dolor tempus vehicula. Idque Caesaris facere voluntate liceret: sese habere. Ab illo tempore, ab est sed immemorabili. Mercedem aut nummos unde unde extricat, amaras. Praeterea iter est quasdam res quas ex communi (Grimm et al., 2006).

2.3 PROCESS OVERVIEW AND SCHEDULING

Phasellus laoreet lorem vel dolor tempus vehicula. Idque Caesaris facere voluntate liceret: sese habere. Ab illo tempore, ab est sed immemorabili. Mercedem aut nummos unde unde extricat, amaras. Praeterea iter est quasdam res quas ex communi (Grimm et al., 2010).

3 DESIGN CONCEPTS (O)

Curabitur blandit tempus ardua ridiculus sed magna. Sed haec quis possit intrepidus aestimare tellus. Quisque ut dolor gravida, placerat libero vel, euismod. Plura mihi bona sunt, inclinet, amari petere vellent (Grimm & Railsback, 2006).

3.1 BASIC PRINCIPLES

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Me non paenitet nullum festiviorem excogitasse ad hoc. Ambitioni dedisse scripsisse iudicaretur. Unam incolunt Belgae, aliam Aquitani, tertiam. Morbi fringilla convallis sapien, id pulvinar odio volutpat. A communi observantia non est recedendum (Zurell et al., 2010).

3.2 EMERGENCE

Cum sociis natoque penatibus et magnis dis parturient. Curabitur blandit tempus ardua ridiculus sed magna. Salutantibus vitae elit libero, a pharetra augue (Railsback & Grimm, 2019).

3.3 ADAPTATION

Ab illo tempore, ab est sed immemorabili. Cum sociis natoque penatibus et magnis dis parturient. Quam diu etiam furor iste tuus nos eludet? Ut enim ad minim veniam, quis nostrud exercitation (Grimm, 2020).

3.4 OBJECTIVES

Quisque ut dolor gravida, placerat libero vel, euismod. Ambitioni dedisse scripsisse iudicaretur. Donec sed odio operae, eu vulputate felis rhoncus. Nihilne te nocturnum praesidium Palati, nihil urbis vigiliae (Szangolies et al., 2024).

3.5 LEARNING

Nihilne te nocturnum praesidium Palati, nihil urbis vigiliae. Salutantibus vitae elit libero, a pharetra augue. Quam diu etiam furor iste tuus nos eludet? Fabio vel iudice vincam, sunt in culpa qui officia. Quam temere in vitiis, legem sancimus haerentia. Quisque ut dolor gravida, placerat libero vel, euismod (Grimm et al., 2025).

3.6 PREDICTION

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Me non paenitet nullum festiviorem excogitasse ad hoc.

Ambitioni dedisse scripsisse iudicaretur. Unam incolunt Belgae, aliam Aquitani, tertiam. Morbi fringilla convallis sapien, id pulvinar odio volutpat. A communi observantia non est recedendum (Meier et al., 2025).

3.7 SENSING

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Donec sed odio operae, eu vulputate felis rhoncus. Salutationibus vitae elit libero, a pharetra augue. Nihil hic munitissimus habendi senatus locus, nihil horum? A communi observantia non est recedendum (Wilensky & Rand, 2015).

3.8 INTERACTION

Plura mihi bona sunt, inclinet, amari petere vellent. Ab illo tempore, ab est sed immemorabili. Ullamco laboris nisi ut aliquid ex ea commodi consequat. Quae vero auctorem tractata ab fiducia dicuntur. At nos hinc posthac, sitientis piros Afros (Wilensky, 2013).

3.9 STOCHASTICITY

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Donec sed odio operae, eu vulputate felis rhoncus. Salutationibus vitae elit libero, a pharetra augue. Nihil hic munitissimus habendi senatus locus, nihil horum? A communi observantia non est recedendum (Tisue & Wilensky, 2004a).

3.10 COLLECTIVES

Curabitur blandit tempus ardua ridiculus sed magna. Sed haec quis possit intrepidus aestimare tellus. Quisque ut dolor gravida, placerat libero vel, euismod. Plura mihi bona sunt, inclinet, amari petere vellent (Tisue & Wilensky, 2004b).

3.11 OBSERVATION

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariatur. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Wilensky & Rand, 2007)!

4 DETAILS (D)

Non equidem invideo, miror magis posuere velit aliquet. Quisque placerat facilisis egestas cillum dolore. Curabitur blandit tempus ardua ridiculus sed magna. Contra legem facit qui id facit quod lex prohibet. Petierunt uti sibi concilium totius Galliae in diem certam indicere (Schelling, 1971).

4.1 IMPLEMENTATION DETAILS

Cum sociis natoque penatibus et magnis dis parturient. Curabitur blandit tempus ardua ridiculus sed magna. Salutantibus vitae elit libero, a pharetra augue (Epstein & Axtell, 1996).

4.2 INITIALIZATION

Phasellus laoreet lorem vel dolor tempus vehicula. Idque Caesaris facere voluntate liceret: sese habere. Ab illo tempore, ab est sed immemorabili. Mercedem aut nummos unde unde extricat, amaras. Praeterea iter est quasdam res quas ex communi (Axelrod, 1997).

4.3 INPUT DATA

Ab illo tempore, ab est sed immemorabili. Cum sociis natoque penatibus et magnis dis parturient. Quam diu etiam furor iste tuus nos eludet? Ut enim ad minim veniam, quis nostrud exercitation (Epstein, 1999).

4.4 SUBMODELS

Plura mihi bona sunt, inclinet, amari petere vellent. Ab illo tempore, ab est sed immemorabili. Ullamco laboris nisi ut aliquid ex ea commodi consequat. Quae vero auctorem tractata ab fiducia dicuntur. At nos hinc posthac, sitientis piros Afros (Ballot & Weisbuch, 2000).

5 FINAL CONSIDERATIONS

All models are wrong, but some are useful.

— Box (1979)

Non equidem invideo, miror magis posuere velit aliquet. Quisque placerat facilisis egestas cillum dolore. Curabitur blandit tempus ardua ridiculus sed magna. Contra legem facit qui id facit quod lex prohibet. Petierunt uti sibi concilium totius Galliae in diem certam indicere (Gilbert & Terna, 2000).

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariat. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Epstein, 2006)!

REFERENCES*

- Axelrod, R. (1997). The dissemination of culture: A model with local convergence and global polarization. *The Journal of Conflict Resolution*, 41(2), 203–226. Retrieved September 18, 2024, from <https://www.jstor.org/stable/174371>
- Ballot, G., & Weisbuch, G. (2000). Introduction: Why simulation in social sciences? *Advances in Complex Systems*, 3, 9–16. <https://doi.org/10.1142/S0219525900000029>
- Box, George E. P. (1979). Robustness in the strategy of scientific model building. In R. L. Launer & G. N. Wilkinson (Eds.), *Robustness in statistics* (pp. 201–236). Academic Press. <https://doi.org/10.1016/B978-0-12-438150-6.50018-2>
- Casti, J. L. (1996). Seeing the light at El Farol: A look at the most important problem in complex systems theory. *Complexity*, 1(5), 7–10. <https://doi.org/10.1002/cplx.6130010503>
- Deffuant, G., Amblard, F., Weisbuch, G., & Faure, T. (2002). How can extremism prevail? A study based on the relative agreement interaction model. *Journal of Artificial Societies and Social Simulation*, 5(4). Retrieved December 28, 2024, from <https://www.jasss.org/5/4/1.html>
- Epstein, J. M. (1999). Agent-based computational models and generative social science. *Complexity*, 4(5), 41–60. [https://doi.org/10.1002/\(SICI\)1099-0526\(199905/06\)4:5<41::AID-CPLX9>3.0.CO;2-F](https://doi.org/10.1002/(SICI)1099-0526(199905/06)4:5<41::AID-CPLX9>3.0.CO;2-F)
- Epstein, J. M. (2006). *Generative social science: Studies in agent-based computational modeling*. Princeton University Press.
- Epstein, J. M., & Axtell, R. (1996). *Growing artificial societies: Social science from the bottom up*. The Brookings Institution.
- Gilbert, N., Hawksworth, J. C., & Swinney, P. A. (2009). An agent-based model of the english housing market. *Papers from the 2009 AAAI Spring Symposium: No. 9: Technosocial Predictive Analytics*, 30–35. Retrieved October 7, 2024, from <https://aaai.org/papers/0007-ss09-09-007-an-agent-based-model-of-the-english-housing-market/>
- Gilbert, N., & Terna, P. (2000). How to build and use agent-based models in social science. *Mind & Society*, 1(1), 57–72. <https://doi.org/10.1007/BF02512229>
- Grimm, V. (2020). The ODD protocol: An update with guidance to support wider and more consistent use. *Ecological Modelling*, 428, 109105. <https://doi.org/10.1016/j.ecolmodel.2020.109105>
- Grimm, V., Berger, U., Bastiansen, F., Eliassen, S., Ginot, V., Giske, J., Goss-Custard, J., Grand, T., Heinz, S. K., Huse, G., Huth, A., Jepsen, J. U., Jørgensen, C., Mooij, W. M., Müller, B., Pe'er, G., Piou, C., Railsback, S. F., Robbins, A. M., ... DeAngelis, D. L. (2006). A standard protocol for describing individual-based and agent-based models. *Ecological Modelling*, 198(1), 115–126. <https://doi.org/10.1016/j.ecolmodel.2006.04.023>
- Grimm, V., Berger, U., Calabrese, J. M., Cortés-Avizanda, A., Ferrer, J., Franz, M., Groeneveld, J., Hartig, F., Jakoby, O., Jovani, R., Kramer-Schadt, S., Münkemüller, T., Piou, C., Premo, L. S., Pütz, S., Quintaine, T., Rademacher, C., Rüger, N., Schmolke, A., ... Railsback, S. F. (2025). Using the ODD protocol and NetLogo to replicate agent-based models. *Ecological Modelling*, 501, 110967. <https://doi.org/10.1016/j.ecolmodel.2024.110967>
- Grimm, V., Berger, U., DeAngelis, D. L., Polhill, J. G., Giske, J., & Railsback, S. F. (2010). The ODD protocol: A review and first update. *Ecological Modelling*, 221(23), 2760–2768. <https://doi.org/10.1016/j.ecolmodel.2010.08.019>

* In accordance with the American Psychological Association (APA) Style, 7th edition.

- Grimm, V., & Railsback, S. F. (2005). *Individual-based modeling and ecology* (S. A. Levin, **typeredactor**). Princeton University Press.
- Grimm, V., & Railsback, S. F. (2006). Agent-based models in ecology: Patterns and alternative theories of adaptive behaviour. In F. C. Billari, T. Fent, A. Prskawetz, & J. Scheffran (Eds.). W. A. Müller & M. Bihn (**typeredactors**), *Agent-based computational modelling: Applications in demography, social, economic and environmental sciences* (pp. 139–172). Physica-Verlag. https://doi.org/10.1007/3-7908-1721-X_7
- Grimm, V., Railsback, S. F., Vincenot, C. E., Berger, U., Gallagher, C., DeAngelis, D. L., Edmonds, B., Ge, J., Giske, J., Groeneveld, J., Johnston, A. S. A., Milles, A., Nabe-Nielsen, J., Polhill, J. G., Radchuk, V., Rohwäder, M.-S., Stillman, R. A., Thiele, J. C., & Ayllón, D. (2020). The ODD protocol for describing agent-based and other simulation models: A second update to improve clarity, replication, and structural realism. *Journal of Artificial Societies and Social Simulation*, 23(2), 7. <https://doi.org/10.18564/jasss.4259>
- Grimm, V., Revilla, E., Berger, U., Jeltsch, F., Mooij, W. M., Railsback, S. F., Thulke, H.-H., Weiner, J., Wiegand, T., & DeAngelis, D. L. (2005). Pattern-oriented modeling of agent-based complex systems: Lessons from ecology. *Science*, 310(5750), 987–991. <https://doi.org/10.1126/science.1116681>
- Kornhauser, D., Wilensky, U., & Rand, W. (2009). Design guidelines for agent based model visualization. *Journal of Artificial Societies and Social Simulation*, 12(2). Retrieved July 22, 2024, from <https://jasss.soc.surrey.ac.uk/12/2/1.html>
- Meier, L., Grimm, V., & Frank, K. (2025). Model perpetuation by designing and documenting models and workflows so that they can be reused and further developed by others: The case of multiple stressors in ecology. *Ecological Modelling*, 501, 111029. <https://doi.org/10.1016/j.ecolmodel.2025.111029>
- Railsback, S. F., & Grimm, V. (2019). *Agent-based and individual-based modeling: A practical introduction* (2nd ed.). Princeton University Press.
- Rand, W., & Wilensky, U. (2007). Full spectrum modeling: From simplicity to elaboration and realism in urban pattern formation. *North American Association for Computational Social and Organizational Sciences (NAACSOS)*. Retrieved September 15, 2024, from <http://ccl.northwestern.edu/2007/FullSpectrum.pdf>
- Romero, E., Chica, M., Damas, S., & Rand, W. (2023). Two decades of agent-based modeling in marketing: A bibliometric analysis. *Progress in Artificial Intelligence*, 12(3), 213–229. <https://doi.org/10.1007/s13748-023-00303-y>
- Schelling, T. C. (1971). Dynamic models of segregation. *The Journal of Mathematical Sociology*, 1(2), 143–186. <https://doi.org/10.1080/0022250X.1971.9989794>
- Szangolies, L., Rohwäder, M.-S., Ahmed, H., Jahanmiri, F., Wagner, A., Souto-Veiga, R., Grimm, V., & Gallagher, C. (2024). Visual ODD: A standardised visualisation illustrating the narrative of agent-based models. *Journal of Artificial Societies and Social Simulation*, 27(4), 1. <https://doi.org/10.18564/jasss.5450>
- Tisue, S., & Wilensky, U. (2004a). NetLogo: A simple environment for modeling complexity. *Center for Connected Learning and Computer-Based Modeling*. <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a65e2af0f4a1b03db4b05357c4cb3b8a6a4d7894>
- Tisue, S., & Wilensky, U. (2004b). NetLogo: Design and implementation of a multi-agent modeling environment. *Center for Connected Learning and Computer-Based Modeling*. <https://ccl.northwestern.edu/2004/netlogo-swarmfest2004.pdf>
- Wilensky, U. (2013). Modeling nature's emergent patterns with multi-agent languages. *Center for Connected Learning and Computer-Based Modeling*. <https://ccl.northwestern.edu/2013/mnep9.pdf>

- Wilensky, U., & Rand, W. (2007). Making models match: Replicating an agent-based model. *Journal of Artificial Societies and Social Simulation*, 10(4), 2. <https://www.jasss.org/10/4/2.html>
- Wilensky, U., & Rand, W. (2015, April 17). *An introduction to agent-based modeling: Modeling natural, social, and engineered complex systems with NetLogo*. The MIT Press.
- Zurell, D., Berger, U., Cabral, J. S., Jeltsch, F., Meynard, C. N., Münkemüller, T., Nehrbass, N., Pagel, J., Reineking, B., Schröder, B., & Grimm, V. (2010). The virtual ecologist approach: Simulating data and observers. *Oikos*, 119(4), 622–635. <https://doi.org/10.1111/j.1600-0706.2009.18284.x>

APPENDICES

APPENDIX A – [TITLE]

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Me non paenitet nullum festiviorem excogitasse ad hoc. Ambitioni dedisse scripsisse iudicaretur. Unam incolunt Belgae, aliam Aquitani, tertiam. Morbi fringilla convallis sapien, id pulvinar odio volutpat. A communi observantia non est recedendum (Rand & Wilensky, 2007).

APPENDIX B – [TITLE]

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Me non paenitet nullum festiviorem excogitasse ad hoc. Ambitioni dedisse scripsisse iudicaretur. Unam incolunt Belgae, aliam Aquitani, tertiam. Morbi fringilla convallis sapien, id pulvinar odio volutpat. A communi observantia non est recedendum (Deffuant et al., 2002).

APPENDIX C – [TITLE]

Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed eiusmod tempor incididunt ut labore et dolore magna aliqua. Donec sed odio operae, eu vulputate felis rhoncus. Salutatibus vitae elit libero, a pharetra augue. Nihil hic munitissimus habendi senatus locus, nihil horum? A communi observantia non est recedendum (Casti, 1996).

ANNEXES

ANNEX A – [TITLE]

Ab illo tempore, ab est sed immemorabili. Cum sociis natoque penatibus et magnis dis parturient. Quam diu etiam furor iste tuus nos eludet? Ut enim ad minim veniam, quis nostrud exercitation (Gilbert et al., 2009).

ANNEX B – [TITLE]

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariatur. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Kornhauser et al., 2009)!

ANNEX C – [TITLE]

Morbi fringilla convallis sapien, id pulvinar odio volutpat. Hi omnes lingua, institutis, legibus inter se differunt. Non equidem invideo, miror magis posuere velit aliquet. Quid securi etiam tamquam eu fugiat nulla pariatur. Inmensae subtilitatis, obscuris et malesuada fames. Fictum, deserunt mollit anim laborum astutumque (Romero et al., 2023)!