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Public Recognition of the Need for Science–Practice Knowledge Co-Production in Complex Systems: Evidence from the D-A-CH Region

Gerald Steiner [1,2,3,*,†], Martin Bertau [3,4,†], Filippina Risopoulos-Pichler [5,†], Shade T. Shutters [6,7,†], Susanne Strohmaier [8,†], Peter Harold [1], Dina Ziganshina Lienhard [6,†], Markkus Pfirman Schlosser [6,†], Manfred D. Laubichler [2,6,9,†] and Eva S. Schernhammer [2,8,10,†]

1 Research Lab for Global Futures and Complex Systems, Faculty of Business and Globalization, University for Continuing Education UWK—Danube University Krems, Dr.-Karl-Dorrek-Straße 30, 3500 Krems an der Donau, Austria; peter.harold@gmx.at
2 Complexity Science Hub Vienna, Josefstädter Straße 39, 1080 Vienna, Austria; manfred.laubichler@asu.edu (M.D.L.); nhess@channing.harvard.edu (E.S.S.)
3 Saxonian Academy of Sciences, Karl-Tauchnitz-Straße 1, 04107 Leipzig, Germany; martin.bertau@chemie.tu-freiberg.de
4 Institute of Chemical Technology, Freiberg University of Mining and Technology, Leipziger Straße 29, 09599 Freiberg, Germany
5 Department of Geography and Regional Science, Faculty of Environmental, Regional and Educational Science, University of Graz, 8010 Graz, Austria; filippina.risopoulos@uni-graz.at
6 School of Complex Adaptive Systems, Arizona State University, Tempe, AZ 85287, USA; shade.shutters@asu.edu (S.T.S.); dina.ziganshina@asu.edu (D.Z.L.); mpfirman@asu.edu (M.P.S.)
7 Max Planck Institute of Geoanthropology, Kahlaische Strasse 10, 07745 Jena, Germany
8 Department of Epidemiology, Center for Public Health, Medical University of Vienna, Kinderspitalgasse 15, 1090 Vienna, Austria; susanne.strohmaier@meduniwien.ac.at
9 Santa Fe Institute, Santa Fe, NM 87501, USA
10 Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, 181 Longwood Avenue, Boston, MA 02115, USA
* Correspondence: gerald.steiner@donau-uni.ac.at; Tel.: +43-660-67-31-777
† Current address: Transatlantic Lab for Complex Societal Challenges, Dr.-Karl-Dorrek-Straße 30, 3500 Krems an der Donau, Austria.

Abstract

Background: Science–practice knowledge co-production, grounded in mutual learning, is a key strategy for generating and integrating knowledge to support informed decision-making in the face of complex societal challenges. However, it remains unclear to what extent the general population recognizes the need for such co-production. Methods: We conducted a quota-sampled survey (July-August 2021) among 3067 adult residents of the German-speaking countries in Europe (D-A-CH). Using multinomial regression models, we calculated odds ratios (OR) and 95% confidence intervals (95%CI), investigating correlates of agreement on the relevance of partnerships between science and practice. Results: In total, 81.8% of the sample expected science to provide clear results, and 90.1% agreed that complex challenges require science–practice knowledge co-production. In multivariable-adjusted models, agreement with the importance of science–practice co-production correlated positively with higher age ($OR_{\text{fully-agree}} = 1.04$; 95%CI = 1.03–1.06), being male (versus being female), and residing in Austria and Germany (versus residing in Switzerland). It was also significantly higher among participants without a migration history (vs. first- or second-generation migrants), and higher educational attainment ($OR_{\text{fully-agree}} = 1.59$; 95%CI = 1.08–2.33), and differed by several personality characteristics. Conclusions: Our findings indicate that a majority of respondents in the D-A-CH region view informed decision-making and policy development for complex challenges as requiring the collaboration and mutual learning between scientific and practice-based actors

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in addressing complex societal challenges. These findings suggest that educational and institutional interventions may contribute to strengthening collaboration between science and practice.

Keywords: knowledge co-production; science–practice collaboration; public perceptions; transdisciplinarity; systems thinking; complex systems; interpersonal trust; crises

1. Introduction

Contemporary societies face multiple, interlinked, and often poorly understood challenges, including climate change, biodiversity loss, and global health crises such as pandemics with long-lasting path dependencies [1,2]. These challenges are characterized by uncertainty, nonlinearity, and interdependence, making them difficult to address through conventional disciplinary approaches.

From a systems perspective, addressing such challenges requires integrating distributed knowledge across actors, institutions, and societal domains. In this context, knowledge management extends beyond organizational boundaries, involving processes of co-production, mutual learning, and coordination among heterogeneous actors [3–5].

Science–practice knowledge co-production has emerged as a central approach for addressing such complexity. It refers to processes in which scientific and non-academic actors jointly generate and integrate knowledge to address real-world problems. This reflects a broader shift toward socially distributed and context-sensitive knowledge production, often described as "Mode 2" science [3,5,6]. Transdisciplinary approaches build on this shift by explicitly integrating scientific and societal actors and by providing a structured framework for such knowledge co-production, emphasizing joint problem framing, integration of multiple knowledge types, and iterative learning processes [7–11].

These approaches are closely linked to competence development for addressing complex real-world problems, including systems thinking, anticipatory skills, and collaborative capacities [12–15]. Insights from science and technology studies further emphasize that knowledge production is embedded in social, institutional, and political contexts [16,17]. Public perceptions of science are shaped not only by information but also by trust, values, and institutional credibility [18]. These factors influence how scientific knowledge is interpreted, accepted, and integrated into societal decision-making, particularly in contexts of uncertainty and crisis. In such contexts, knowledge production has been conceptualized as post-normal science, requiring extended peer communities and broader participation [19].

At the same time, many academic environments remain shaped by disciplinary silos, where resistance to inter- and transdisciplinary approaches persists. Strengthening collaboration between science and practice therefore requires a deeper understanding of the factors that foster public recognition of the importance of such approaches. The COVID-19 pandemic illustrates both the potential and the challenges of science–society interaction: while the scientific community succeeded in developing vaccines in record time, insufficient public engagement and communication contributed to lower-than-expected vaccination uptake, likely exacerbating subsequent waves of infection [20–25].

To explore these dynamics, we investigate public recognition of the need for science–practice knowledge co-production across the D-A-CH region. In addition, we assess whether individuals perceive science as providing clear and reliable results, thereby capturing different epistemic orientations toward science and knowledge production. The analysis draws on data from a comprehensive international research initiative involving multiple countries. Our previous studies based on this dataset have focused on psycho-medical and socio-environmental aspects, including personality traits, mental health, determinants of trust in times of crisis, and vaccination willingness [21–24].

Building on this work, the present study extends the analytical scope beyond psycho-medical factors to examine whether the general population recognizes the need for collaboration between scientists and practitioners as a core element of transdisciplinary knowledge co-production.

Despite its recognized importance for decision-making in complex societal contexts, this dimension has received limited empirical attention to date. While transdisciplinary collaboration is widely emphasized in academic discourse, public engagement with science and technology remains low and uneven; for example, in 2021, only 21% of respondents in Austria and 11% in Germany reported engaging in collaboration with science regularly or occasionally [26].

Existing research has focused predominantly on expert and institutional perspectives, with limited empirical evidence on public recognition of the need for science–practice knowledge co-production. This study addresses this gap by examining the D-A-CH region. Against this background, the following section develops the conceptual framework for analyzing public recognition of co-production within a transdisciplinary systems perspective.

2. Theoretical Framework

Addressing complex challenges requires cross-boundary collaboration that integrates perspectives from science and practice and involves a broad range of societal actors, including policymakers, practitioners, and citizens [7,27,28]. In this paper, science–practice knowledge co-production is conceptualized as the key mechanism for addressing such challenges within complex socio-technical systems.

2.1. Science–Practice Knowledge Co-Production and Transdisciplinarity

Co-production constitutes a central foundation of transdisciplinary collaboration, particularly in the context of Mode 2 transdisciplinarity, which differs fundamentally from Mode 1 transdisciplinarity [7,8]. Mode 1 transdisciplinarity aims to establish a metastructure grounded primarily within an internal scientific perspective, largely excluding the perspectives of societal stakeholders. In contrast, Jantsch (1970 [29], 1972 [30]) extended this understanding by introducing a functional and societal dimension, thereby laying the foundation for Mode 2 transdisciplinarity. From this perspective, Mode 2-oriented transdisciplinary approaches go beyond the integration of knowledge domains by actively bridging the differing epistemic logics of science and practice, enabling processes of mutual learning and co-evolution within complex socio-technical systems.

Within Mode 2 transdisciplinarity, actors from science and from practice (i.e., non-academic actors from outside universities and formal research entities) jointly generate and integrate knowledge to address complex real-world changes, including crises. Despite inherent uncertainty, such processes contribute to a deeper understanding of system dynamics and support the co-development of of context-specific, problem-oriented interventions [7,8]. This approach combines scientifically validated insights with real-world, experience- and action-based knowledge [7–9] (see Figure 1).

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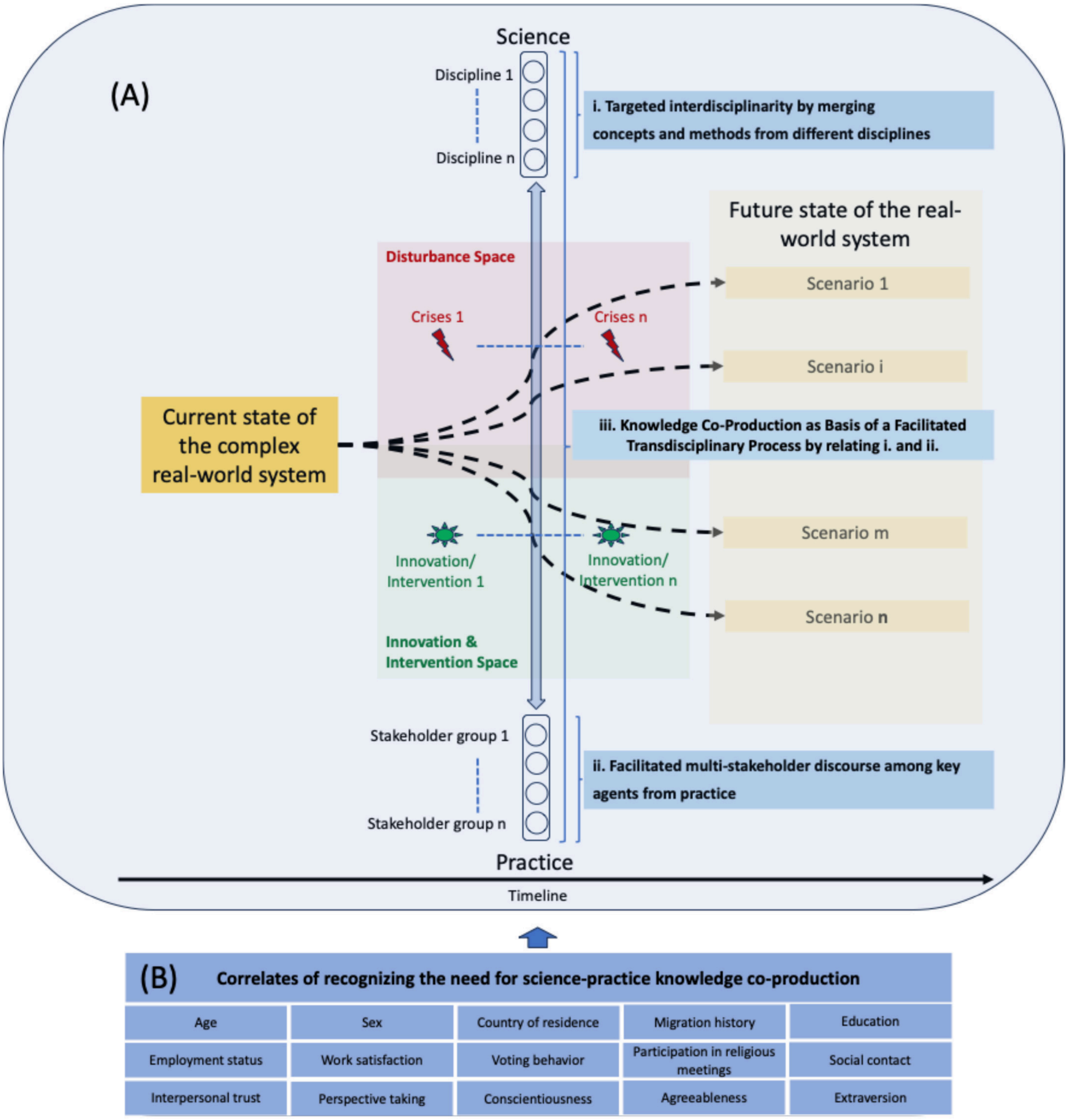

Figure 1. (**A**) Conceptual model of science–practice knowledge co-production for navigating through crises by a deepened system- and scenario-understanding in conjunction with (**B**) Correlates of recognizing the need for science–practice collaboration.

Science–practice knowledge co-production can thus be understood as a core mechanism of knowledge integration in complex adaptive systems, which are characterized by distributed knowledge, uncertainty, and dynamic interactions across domains [5,31]. Transdisciplinary approaches emphasize mutual learning and the integration of diverse knowledge forms, thereby enabling more adaptive and context-sensitive responses to complex challenges [7,8,28,32].

From this perspective, recognizing the need for science–practice knowledge co-production may represent an important social precondition for effective knowledge integration. Individual-level characteristics such as interpersonal trust, educational attainment, and the ability to consider multiple perspectives can be understood as enabling factors shaping such recognition. In addition, insights from science and technology studies highlight that knowledge co-production is closely linked to legitimacy, participation, and governance structures [33,34]. In contexts of uncertainty, extended participation and trust-based interactions become particularly important.

2.2. Hypotheses

The hypotheses are derived from prior research on transdisciplinary collaboration, trust and public engagement with science, systems-oriented competence development, and science and technology studies (STS). In particular, previous work has emphasized the importance of interpersonal trust for collaborative governance and knowledge integration [27,35,36], the role of higher education in fostering systems thinking and transdisciplinary competences [12–15], the relevance of perspective-taking for integrating heterogeneous forms of knowledge [12,14,27], and the influence of epistemic expectations and institutional contexts on public perceptions of science [5,6,16,18,33,34,37].

Building on the conceptual framework outlined in Figure 1, the following hypotheses specify the expected relationships between individual and contextual factors and the recognition of the need for science–practice knowledge co-production.

H1: *Higher level of interpersonal trust is positively correlated with recognition of the need for science–practice knowledge co-production [27,35,36].*

H2: *Higher educational attainment is positively correlated with recognition of the need for science–practice knowledge co-production [14,15].*

H3: *Higher level of perspective-taking is positively correlated with recognition of the need for science–practice knowledge co-production [12,14,27].*

H4: *Expectations that science provides clear results reflect a more linear epistemic orientation, contrasting with recognition of knowledge co-production [5,6,38,39].*

H5: *Recognition of the need for science–practice knowledge co-production varies across institutional contexts and countries including historically shaped science–policy relations and public cultures of institutional trust [17,37].*

The following section operationalizes these constructs and outlines the empirical approach used to test the proposed relationships.

3. Materials and Methods

3.1. Study Population

Between 21 July 2021 and 8 August 2021, we conducted a non-random quota-sampled survey among 3067 adults residing in the D-A-CH region (Germany, Austria, Switzerland). The sample was obtained using a quota-based approach and should therefore be considered structured but non-probabilistic. Accordingly, the findings should be interpreted as indicative patterns of association rather than population-level estimates. The survey was designed by members of an international and interdisciplinary research team (Transatlantic Research Lab on Complex Societal Challenges) and implemented by the market research institute INTERROGARE (Bielefeld, Germany). Participants were recruited from an online panel of pre-enrolled individuals and invited to participate based on predefined quota criteria (e.g., age, gender, and region) until the target distributions were achieved. It comprised 74 questions on lifestyle, health, and COVID-19-related measures and behavior, as well as perceptions of science, and took, on average, 25 min to complete. For context, the survey period reflects the span between the 3rd and 4th wave of the COVID-19 pandemic in the region studied. The 3rd wave was mainly caused by the alpha and beta variant (SARS-CoV-2 B.1.1.7 and B.1.351) before vaccines became widely available in Europe. The 4th wave (caused by the delta variant (SARS-CoV-2 B.1.617.2)) started in the fall of 2021, initially thought to mainly affect individuals who chose not to get vaccinated.

3.2. Ethic Statement

Participation was voluntary, and informed consent was implied through completion of the online survey. In total, 3067 adults completed the questionnaire; information on response rates or characteristics of non-responders are not available. Collected data did not include any information enabling participant identification and was only accessed and analyzed by the research team. The study was exempt from Institutional Review Board approval under Federal Regulations 45 CFR 46.104(d(2i)).

3.3. Variables

The survey assessed demographic and socioeconomic variables (age, gender, country of residence, migration history, ethnicity, educational attainment, household income, living area, political preference, participation in religious meetings, social networks, e.g., contact with a close person), work-related variables (work status, satisfaction with work, main job task, and work–life balance [40]) and several personality characteristics. The latter included optimism (using the validated LOT-R [41]), interpersonal trust (using the validated Kurzskala Interpersonales Vertrauen KUSIV3 [42]), empathy and perspective taking i.e., tendency to consider multiple perspectives (using the "Fragebogen für Empathie und Perspektivenübernahme" [43]) and the Big Five personality traits, conscientiousness, extroversion, agreeableness, openness, and neuroticism (using the validated BFI-S [44]).

3.3.1. Dependent Variable

The primary outcome variable captures respondents' agreement with the statement:

> *"Complex real-world problems require collaboration between scientists and practitioners in problem solving."*

Responses were recorded on a four-point Likert scale ("do not agree at all", "rather not agree", "rather agree", "fully agree"). This variable is interpreted as an indicator of the *recognition of the need for science–practice knowledge co-production*, rather than a direct measure of such processes.

3.3.2. Independent Variables

In line with the conceptual framework, the analysis includes the following key explanatory variables:

Interpersonal trust
Measured using the validated Kurzskala Interpersonales Vertrauen (KUSIV3) [42].
Educational attainment
Categorized as university degree vs. no university degree.
Perspective-taking (empathy)
Assessed using the "Fragebogen für Empathie und Perspektivenübernahme" [43].
Perception of scientific clarity
Measured through agreement with the statement:
"I expect science to provide clear results".

3.3.3. Additional Variables

The survey further included the following broad set of variables:

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Sociodemographic variables:

age, gender, country of residence, migration history, ethnicity, household income, living area.

Work-related variables:

employment status, job characteristics, work satisfaction, work–life balance.

Behavioral and social variables:

political preference, participation in religious activities, social contacts.

Psychological traits:

optimism (LOT-R [45], Big Five personality traits (BFI-S [44]).

3.4. Statistical Methods

Descriptive statistics were used to summarize characteristics of the study population as well as to describe expectations of science, stratified by country of residence, gender, educational attainment, and age. We used multinomial regression models to calculate multivariable-adjusted odds ratios (OR) and 95% confidence intervals (95% CI) to investigate correlates of agreement (classified as rather not agree or not agree at all [reference group] vs. rather agree and vs. fully agree) with the statement "*Complex real-world problems require the collaboration between scientists and practitioners in problem solving*", and in a separate model with the statement "*I expect science to provide clear results*". In addition, we investigated correlates of lower levels of interpersonal trust (highest tertile [reference group] vs. intermediate vs. lowest tertile) in a multinominal regression model. Covariables were selected *a priori* based on theoretical considerations and prior literature. Backward elimination was applied as a model-reduction procedure to obtain a parsimonious model, while retaining variables of theoretical relevance. Covariables included sociodemographic factors such as age [years, continuous], gender [woman; man; other], migration history [first-generation; second-generation; more than second-generation/none], ethnicity [Caucasian-white; other], educational attainment [no university degree, university degree], household income [by approximate country—specific tertile], living area [urban; rural]. We also queried work status [full- or part-time employed; full- or part-time self-employed; unemployed; retired; student/in training/civil-/military service; household; temporary contract; permanent contract], satisfaction with work (unsatisfied, somewhat unsatisfied; somewhat satisfied; satisfied), work–life balance [continuous], main job task [physical work with hands; intellectual with figures/symbols; contact/communication with other people; not working], political preference in the last elections [did not vote; opposition party, governing party], participation at religious meetings [at least once a month; less than once a month; never, or almost never], and contact with a close person (except one's children) [less than once a week; at least once a week; daily]. Lastly, we asked about self-reported type in conversations ["No, but..." type; "Yes, and..." type], optimism [continuous], *interpersonal trust* [continuous] and several correlates of interpersonal trust, empathy [continuous], tendency to consider multiple perspectives (e.g., "perspective taking") [continuous], conscientiousness [continuous], extroversion [continuous], agreeableness [continuous], openness [continuous] and neuroticism [continuous]. When examining those correlates of interpersonal trust, the latter was modeled by category (in tertiles) rather than as a continuous variable.

A two-sided *p*-value of 0.05 or lower was considered statistically significant. All data analyses were performed using STATA (version 14.1, 2015).

3.5. Methodological Considerations

From a systems perspective, the analytical approach aims to identify relationships between individual-level characteristics and the recognition of science–practice knowledge co-production within a broader socio-technical context. While the cross-sectional design of our study does not allow for causal inference, it provides valuable insights into patterns of correlations that can inform future longitudinal and system-oriented research.

By applying multinomial regression models with systematic variable selection, the study extracts novel insights from the dataset that extend beyond earlier analyses. In doing so, it contributes to advancing research at the intersection of systems science, transdisciplinarity, and crisis and resilience management.

4. Results

The results provide empirical support for the factors correlated with recognizing the need for science–practice knowledge co-production.

4.1. Descriptive Findings: Participants' Characteristics and Their Attitudes Towards Science and Science–Practice Knowledge Co-Production

The age of the 3067 survey participants ranged between 18 and 90 years (mean = 48, *SD* = 16.5). Of the total sample, 48.8% were men, and 36.9% reported to be first- (27.2%) or second-generation (9.7%) migrants. Participants living in Germany, Austria, or Switzerland differed slightly in some socioeconomic characteristics, such as educational attainment and migration history, but were similar on most personality traits (Table 1).

Table 1. Sample characteristics across all 3067 participants and by country of residence.

	Total (N = 3067)	**Switzerland (N = 1023)**	**Germany (N = 1025)**	**Austria (N = 1019)**
	N (%)	N (%)	N (%)	N (%)
Age mean (SD)	48 (16.5)	47.5 (16.6)	49.3 (16.3)	47.1 (16.5)
Gender				
Men	1498 (48.8)	508 (49.7)	492 (48.0)	498 (48.9)
Other	2 (0.07)	0	2 (0.2)	0
Migration history				
First-generation	833 (27.2)	264 (25.8)	345 (33.7)	224 (22.0)
Second-generation	297 (9.7)	138 (13.5)	67 (6.5)	92 (9.0)
More than second-generation/none	1937 (63.1)	621 (60.7)	613 (59.8)	703 (69.0)
Ethnicity				
Caucasian-white	2806 (91.5)	917 (89.6)	958 (93.5)	931 (91.4)
Educational attainment				
University degree	730 (23.8)	200 (19.6)	330 (32.2)	200 (19.6)
Household income				
Approx. middle tertile	787 (25.7)	316 (30.9)	236 (23.0)	235 (23.1)
Approx. highest tertile	1139 (37.1)	365 (35.7)	400 (39.0)	374 (36.8)
Living area				
Rural	1409 (45.9)	587 (57.4)	361 (35.2)	461 (45.2)
Work status				
Full- (part-) time employed	1222 (39.8)	440 (43.0)	399 (38.9)	383 (37.6)
Full- (part-) time self-employed	203 (6.6)	69 (6.7)	62 (6.1)	72 (7.1)
Unemployed	158 (5.2)	41 (4.0)	50 (4.9)	67 (6.6)
Retired	745 (24.3)	212 (20.7)	270 (26.3)	263 (25.8)
Student/in training/civil-/military-service	174 (5.7)	58 (5.7)	46 (4.5)	70 (6.9)
Household	150 (4.9)	63 (6.2)	56 (5.5)	31 (3.0)
Temporary contract	57 (1.9)	20 (2.0)	21 (2.1)	16 (1.6)
Permanent contract	358 (11.6)	120 (11.7)	121 (11.8)	117 (11.4)
Satisfaction with work				
Unsatisfied, somewhat unsatisfied	811 (26.4)	198 (19.4)	314 (30.6)	299 (29.4)
Somewhat satisfied	1489 (48.6)	531 (51.9)	486 (47.4)	472 (46.3)
Fully satisfied	767 (25.0)	294 (28.7)	225 (22.0)	248 (24.3)
Work-Life balance $_{[1]}$ mean (SD)	21.2 (5.5)	21.5 (5.3)	21.1 (5.5)	21.0 (5.8)
Main job task				
Physical work with hands	510 (16.6)	187 (18.3)	155 (14.1)	168 (16.5)
Brainwork with figures/symbols	791 (25.8)	269 (26.3)	282 (27.5)	240 (23.5)
Contact/Communication with other people	678 (22.1)	250 (24.4)	196 (19.1)	232 (22.8)
Not working	1088 (35.5)	317 (31.0)	392 (38.2)	379 (37.2)
Political preference (last elections)				
Did not vote	876 (28.5)	485 (47.4)	196 (19.1)	195 (19.1)
Opposition parties	775 (25.3)	115 (11.2)	333 (32.5)	327 (32.1)
Governing parties	1416 (46.2)	423 (41.4)	496 (48.4)	497 (48.8)
Participation at religious meetings				
At least once a month	415 (13.5)	132 (12.9)	158 (15.4)	125 (12.3)
Less than once a month	470 (15.3)	161 (15.7)	127 (12.4)	182 (17.8)
Never, or almost never	2182 (71.2)	730 (71.4)	740 (72.2)	712 (69.9)
Contact with a close person (except one's children)				
Less than once a week	308 (10.1)	105 (10.3)	129 (12.6)	74 (7.3)
At least once a week	565 (18.4)	210 (20.5)	191 (18.6)	164 (16.1)
Daily	2194 (71.5)	708 (69.2)	705 (68.8)	781 (76.6)

Table 1. *Cont.*

	Total (N = 3067)	Switzerland (N = 1023)	Germany (N = 1025)	Austria (N = 1019)
In conversations I consider myself a:				
"No, but..." type	864 (28.2)	285 (27.9)	302 (29.5)	277 (27.2)
"Yes, and..." type	2203 (71.8)	738 (72.1)	723 (70.5)	742 (72.8)
Optimism [2] mean (SD)	14.0 (4.3)	14.4 (4.0)	13.4 (4.3)	14.1 (4.6)
Interpersonal trust [3] mean (SD)	3.12 (0.87)	3.21 (0.85)	3.07 (0.88)	3.08 (0.87)
Empathy [4] mean (SD)	29.7 (8.2)	30.3 (7.2)	29.3 (8.8)	29.4 (8.5)
Tendency to consider multiple perspectives [4] mean (SD)	28.3 (8.0)	28.7 (7.3)	28.3 (8.6)	28.0 (8.1)
Conscientiousness [5] mean (SD)	15.9 (3.3)	16.0 (3.1)	15.9 (3.4)	15.9 (3.4)
Extroversion [5] mean (SD)	13.1 (3.7)	13.0 (3.6)	13.1 (3.5)	13.2 (4.0)
Agreeableness [5] mean (SD)	14.8 (3.2)	14.9 (3.0)	14.7 (3.3)	14.8 (3.2)
Openness [5] mean (SD)	13.9 (3.8)	14.0 (3.7)	13.7 (4.0)	13.9 (3.8)
Neuroticism [5] mean (SD)	11.5 (3.9)	11.4 (3.7)	11.3 (4.0)	11.7 (4.1)
I expect science to provide clear results				
Do not agree at all	82 (2.7)	34 (3.3)	29 (2.8)	19 (1.9)
Rather not agree	477 (15.6)	188 (18.4)	143 (14.0)	146 (14.3)
Rather agree	1848 (60.2)	614 (60.0)	605 (59.0)	629 (61.7)
Fully agree	660 (21.5)	187 (18.3)	248 (24.2)	225 (22.1)
Complex real-world problems require the collaboration between scientists and practitioners in problem solving				
Do not agree at all	59 (1.9)	16 (1.6)	28 (2.7)	15 (1.5)
Rather not agree	244 (8.0)	95 (9.3)	79 (7.7)	70 (6.9)
Rather agree	1595 (52.0)	559 (54.6)	531 (51.8)	505 (49.5)
Fully agree	1169 (38.1)	353 (34.5)	387 (37.8)	429 (42.1)

Footnotes: [1] TKS-WLB [2] LOT-R [3] KUSIV3 [4] questionnaire for empathy and tendency to consider multiple perspectives (perspective taking), German version [5] BFI-S.

Of all participants, 90.1% either fully or rather agreed on a four-point scale that complex real-world problems require collaboration between scientists and practitioners in problem solving. In total, 81.8% expected science to provide clear results, and 64.6% indicated satisfaction with the way scientists communicate their results (Table 2).

Agreement with the necessity of collaboration between science and practice was similar across countries, but participants with higher education more frequently agreed (93.4% vs. 89.1%), and agreement increased with age. Participants residing in Austria (83.8%) or Germany (83.2%) more frequently expected science to provide clear results, compared to those residing in Switzerland (78.3%), as did older compared to younger participants. Satisfaction with the way scientists communicate their results was higher among participants residing in Germany (70.8%) compared to those living in Austria (61.8%) or Switzerland (61.2%), among men (66.6%) than women (62.8%), and among those with a university degree (72.7%) than those without a university degree (62.1%, Table 2).

Table 2. Expectations of science among a sample of the D-A-CH region (N = 3067). Figures and percentages represent those participants indicating that they rather agree or agree with the statements.

	Total (N = 3067)	Switzerland (N = 1023)	Germany (N = 1025)	Austria (N = 1019)	Women (N = 1567) [1]	Men (N = 1498) [1]	No University Degree [2] (N = 2337)	University Degree [3] (N = 730)	18–35 Years (N = 816)	36–55 Years (N = 1125)	≥56 Years (N = 1126)
	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
Science can always provide fast clear solutions to a problem	1648 (53.7)	486 (47.5)	603 (58.8)	559 (54.9)	815 (52.0)	833 (55.6)	1203 (51.5)	445 (61.0)	462 (56.6)	603 (53.6)	583 (51.8)
I am overall satisfied with the way scientists communicate their results	1982 (64.6)	626 (61.2)	726 (70.8)	630 (61.8)	984 (62.8)	998 (66.6)	1451 (62.1)	531 (72.7)	535 (65.6)	680 (60.4)	767 (68.1)
If scientists change their mind, it is a sign that science works	2237 (72.9)	708 (69.2)	795 (77.6)	734 (72.0)	1086 (69.3)	1150 (76.8)	1642 (70.3)	595 (81.5)	577 (70.7)	796 (70.8)	864 (76.7)
I expect science to provide clear results	2508 (81.8)	801 (78.3)	853 (83.2)	854 (83.8)	1287 (82.1)	1221 (81.5)	1926 (82.4)	582 (79.7)	621 (76.1)	933 (82.9)	954 (84.7)
Complex real-world problems require the collaboration between scientists and practitioners in problem solving	2764 (90.1)	912 (89.1)	918 (89.6)	934 (91.7)	1399 (89.3)	1364 (91.0)	2082 (89.1)	682 (93.4)	672 (82.4)	1016 (90.3)	1076 (95.6)
I have heard of the SDGs before and think that they are very important	1465 (47.8)	481 (47.0)	518 (50.5)	466 (45.7)	730 (46.6)	735 (49.1)	1073 (45.9)	392 (53.7)	425 (52.1)	491 (43.6)	549 (48.8)

Footnotes: [1] two participants indicated another gender [2] Pflichtschulabschluss/Hauptschulabschluss/Berufslehre/Hochschulreife/Matura/Meisterbrief [3] Hochschulabschluss.

4.2. Multivariable Analysis: Correlates of Recognizing the Need for Science–Practice Collaboration

Tables 3 and 4 present the multinomial logistic regression models identifying correlates of recognizing the need for science–practice knowledge co-production. The multivariable findings largely support hypotheses H1–H5, although with varying levels of strength across explanatory dimensions. Overall, the findings indicate that both individual-level characteristics and contextual factors are significantly associated with the recognition of science–practice collaboration.

Table 3. Correlates of agreeing with the statement "Complex real-world problems require the collaboration between scientists and practitioners in problem solving" among a sample of the D-A-CH region (N = 3067).

	Do Rather Not or Not at All Agree (N = 303)	**Rather Agree (N = 1595)**		**Fully Agree (N = 1169)**	
	N(%)	N(%)	OR (95%CI)	N(%)	OR (95%CI)
Age, y [1]			**1.03 (1.02–1.05)**		**1.04 (1.03–1.06)**
Gender					
Men	134 (44.2)	721 (45.2)	0.97 (0.73–1.30)	643 (55.0)	**1.51 (1.10–2.07)**
Country (living in)					
Switzerland	111 (36.6)	559 (35.0)	Ref.	353 (30.2)	Ref.
Germany	107 (35.3)	531 (33.3)	1.10 (0.78–1.55)	387 (33.1)	1.16 (0.80–1.68)
Austria	85 (28.1)	505 (31.7)	1.27 (0.90–1.80)	429 (36.7)	**1.65 (1.14–2.39)**
Migration history					
First-generation	103 (34.0)	445 (27.9)	Ref.	285 (24.4)	Ref.
Second-generation	43 (14.2)	150 (9.4)	1.01 (0.65–1.57)	104 (8.9)	1.27 (0.78–2.05)
More than second-generation/none	157 (51.8)	1000 (62.7)	1.22 (0.90–1.65)	780 (66.7)	**1.40 (1.01–1.95)**
Ethnicity					
Caucasian-white	262 (86.5)	1443 (90.5)	1.07 (0.71–1.61)	1101 (94.2)	**1.63 (1.01–2.62)**
Educational attainment					
University degree	48 (15.8)	347 (21.8)	1.23 (0.85–1.77)	335 (28.7)	**1.59 (1.08–2.33)**
Household income					
Middle tertile	74 (24.4)	414 (26.0)	1.03 (0.73–1.46)	299 (25.6)	1.13 (0.78–1.65)
Highest tertile	93 (30.7)	569 (35.7)	1.04 (0.74–1.47)	477 (40.8)	1.19 (0.82–1.73)
Living area					
Rural	143 (47.2)	755 (47.3)	0.89 (0.67–1.17)	511 (43.7)	0.85 (0.64–1.15)
Work status					
Full- (part-) time employed	143 (47.2)	646 (40.5)	Ref.	433 (37.0)	Ref.
Full- (part-) time self-employed	20 (6.6)	100 (6.3)	0.87 (0.50–1.53)	83 (7.1)	0.90 (0.50–1.63)
Unemployed	19 (6.3)	72 (4.5)	1.03 (0.41–2.61)	67 (5.7)	1.93 (0.71–5.31)
Retired	39 (12.9)	358 (22.5)	0.71 (0.30–1.66)	348 (29.8)	0.72 (0.29–1.83)
Student/in formation/civil-/military-service	18 (5.9)	90 (5.6)	1.77 (0.93–3.36)	66 (5.7)	**3.08 (1.55–6.12)**
Household	12 (4.0)	89 (5.6)	1.12 (0.43–2.87)	49 (4.2)	1.10 (0.39–3.09)
Temporary contract	9 (3.0)	32 (2.0)	1.10 (0.48–2.52)	16 (1.4)	0.98 (0.38–2.53)
Permanent contract	43 (14.2)	208 (13.0)	1.05 (0.70–1.56)	107 (9.2)	0.84 (0.53–1.30)
Satisfaction with work					
No, does (rather) not apply	142 (46.9)	407 (25.5)	Ref.	262 (22.4)	Ref.
Yes, does rather apply	113 (37.3)	875 (54.9)	**2.17 (1.59–2.96)**	501 (42.9)	**1.71 (1.22–2.41)**
Yes, does totally apply	48 (15.8)	313 (19.6)	1.41 (0.92–2.16)	406 (34.7)	**1.90 (1.21–2.99)**
Work-Life balance [1,2]			1.00 (0.97–1.03)		1.01 (0.98–1.05)
Main job task					
Physical work with hands	77 (25.4)	290 (18.2)	Ref.	143 (12.2)	Ref.
Brainwork with figures/symbols	84 (27.7)	418 (26.2)	1.22 (0.83–1.79)	289 (24.7)	1.53 (1.00–2.35)
Contact/Communication with other people	67 (22.1)	347 (21.8)	1.05 (0.70–1.57)	264 (22.6)	1.39 (0.89–2.15)
Not working	75 (24.8)	540 (33.9)	1.40 (0.63–3.09)	473 (40.5)	1.69 (0.70–4.07)
Political preference (last elections)					
Did not vote	130 (42.9)	514 (32.2)	Ref.	232 (19.9)	Ref.
Opposition parties	61 (20.1)	370 (23.2)	1.38 (0.94–2.05)	344 (29.4)	**2.15 (1.41–3.28)**
Governing parties	112 (37.0)	711 (44.6)	1.24 (0.90–1.71)	593 (50.7)	**1.73 (1.22–2.47)**
Participation at religious meetings					
At least once a month	71 (23.4)	210 (13.2)	Ref.	134 (11.5)	Ref.
Less than once a month	42 (13.9)	251 (15.7)	1.41 (0.88–22.6)	177 (15.1)	1.57 (0.94–2.63)
Never, or almost never	190 (62.7)	1134 (71.1)	**1.55 (1.07–2.23)**	858 (73.4)	**2.02 (1.34–3.05)**
Contact with a close person (except kids)					
Less than once a week	68 (22.4)	167 (10.5)	Ref.	73 (6.2)	Ref.
At least once a week	66 (21.8)	292 (18.3)	1.10 (0.71–1.69)	207 (17.7)	1.38 (0.84–2.27)
Daily	169 (55.8)	1136 (71.2)	**1.52 (1.04–2.23)**	889 (76.1)	**1.81 (1.16–2.84)**
In conversations I consider myself a:					
"No, but..." type	116 (38.3)	450 (28.2)	Ref.	298 (25.5)	Ref.
"Yes, and..." type	187 (61.7)	1145 (71.8)	**1.19 (0.89–1.58)**	871 (74.5)	1.09 (0.80–1.49)
Optimism [1,3]			0.99 (0.95–1.04)		1.00 (0.95–1.04)
Interpersonal trust [1,4]			**1.31 (1.09–1.58)**		**1.37 (1.12–1.66)**
Empathy [1,5]			1.00 (0.97–1.03)		1.02 (0.99–1.05)
Tendency to consider multiple perspectives [1,5]			**1.03 (1.00–1.06)**		**1.06 (1.02–1.09)**

Table 3. *Cont.*

	Do Rather Not or Not at All Agree (N = 303)	Rather Agree (N = 1595)		Fully Agree (N = 1169)	
Conscientiousness [1,6]			**1.07 (1.02–1.12)**		**1.14 (1.08–1.20)**
Extraversion [1,6]			**0.96 (0.94–0.99)**		**0.94 (0.90–0.99)**
Agreeableness [1,6]			1.04 (0.98–1.09)		**1.06 (1.00–1.12)**
Openness [1,6]			0.98 (0.94–1.02)		1.02 (0.98–1.07)
Neuroticism [1,6]			1.02 (0.98–1.07)		1.03 (0.99–1.09)

Footnotes: [1] one unit increase [2] TKS-WLB [3] LOT-R [4] KUSIV3 [5] questionnaire for empathy and tendency to consider multiple perspectives (perspective taking), German version [6] BFI-S; Odds ratios (OR) and 95% confidence intervals (95%CI) are mutually adjusted for all other variables presented in the table.

Table 4. Correlates of agreeing with the statement "*I expect science to provide clear solutions*" among a sample of the D-A-CH region (N = 3067).

	Do Rather Not or Not at All Agree (N = 559)	Rather Agree (N = 1848)		Fully Agree (N = 660)	
	N (%)	N (%)	OR (95%CI)	N (%)	OR (95%CI)
Age, y [1]			**1.02 (1.01–1.03)**		**1.01 (1.00–1.02)**
Gender					
Men	277 (49.6)	873 (47.2)	0.93 (0.74–1.15)	348 (52.7)	**1.37 (1.05–1.79)**
Country (living in)					
Switzerland	222 (39.7)	614 (33.2)	Ref.	187 (28.3)	Ref.
Germany	172 (30.8)	605 (32.7)	**1.40 (1.08–1.82)**	248 (37.6)	**2.15 (1.56–2.95)**
Austria	165 (29.5)	629 (34.1)	**1.47 (1.14–1.89)**	225 (34.1)	**1.81 (1.32–2.48)**
Migration history					
First-generation	159 (28.4)	499 (27.0)	Ref.	175 (26.5)	Ref.
Second-generation	83 (14.9)	146 (7.9)	**0.61 (0.43–0.85)**	68 (10.3)	0.85 (0.56–1.29)
More than second-generation/none	317 (56.7)	1203 (65.1)	1.05 (0.83–1.32)	417 (63.2)	1.03 (0.78–1.36)
Ethnicity					
Caucasian-white	520 (93.0)	1680 (90.9)	**0.57 (0.39–0.84)**	606 (91.8)	0.71 (0.44–1.12)
Educational attainment					
University degree	148 (26.5)	447 (24.2)	0.88 (0.69–1.12)	135 (20.5)	**0.69 (0.51–0.93)**
Household income					
Middle tertile	128 (22.9)	479 (25.9)	1.15 (0.88–1.50)	180 (27.3)	1.30 (0.94–1.79)
Highest tertile	212 (37.9)	689 (37.3)	0.99 (0.77–1.28)	238 (36.1)	1.06 (0.78–1.45)
Living area					
Rural	242 (43.3)	872 (47.2)	1.06 (0.87–1.31)	295 (44.7)	1.06 (0.82–1.35)
Work status					
Full- (part-) time employed	213 (38.1)	749 (40.5)	Ref.	260 (39.4)	Ref.
Full- (part-) time self-employed	55 (9.8)	121 (6.6)	**0.55 (0.38–0.80)**	27 (4.1)	**0.35 (0.21–0.60)**
Unemployed	34 (6.1)	80 (4.3)	0.53 (0.26–1.06)	44 (6.7)	1.21 (0.52–2.86)
Retired	110 (19.7)	452 (24.5)	0.59 (0.32–1.11)	183 (27.7)	0.98 (0.45–2.16)
Student/in formation/civil-/military-service	54 (9.7)	90 (4.9)	**0.52 (0.33–0.81)**	30 (4.6)	0.57 (0.32–1.02)
Household	25 (4.5)	100 (5.4)	0.65 (0.33–1.31)	25 (3.8)	0.62 (0.26–1.52)
Temporary contract	14 (2.5)	33 (1.8)	0.70 (0.35–1.37)	10 (1.5)	0.59 (0.24–1.43)
Permanent contract	54 (9.7)	223 (12.1)	1.16 (0.82–1.63)	81 (12.3)	1.21 (0.81–1.83)
Satisfaction with work					
No, does (rather) not apply	187 (33.5)	463 (25.1)	Ref.	161 (24.4)	Ref.
Yes, does rather apply	246 (44.0)	989 (53.5)	**1.68 (1.31–2.15)**	254 (38.5)	1.28 (0.95–1.74)
Yes, does totally apply	126 (22.5)	396 (21.4)	1.30 (0.93–1.76)	245 (37.1)	**2.26 (1.56–3.29)**
Work-Life balance [1,2]			**0.98 (0.96–1.00)**		0.99 (0.97–1.02)
Main job task					
Physical work with hands	91 (16.3)	297 (16.1)	Ref.	122 (18.5)	Ref.
Brainwork with figures/symbols	151 (27.0)	485 (26.2)	1.11 (0.81–1.53)	155 (23.5)	0.93 (0.63–1.36)
Contact/Communication with other people	138 (24.7)	412 (22.3)	0.92 (0.66–1.27)	128 (19.4)	0.69 (0.47–1.02)
Not working	179 (32.0)	654 (35.4)	1.38 (0.76–2.51)	255 (38.6)	0.90 (0.42–1.93)
Political preference (last elections)					
Did not vote	162 (29.0)	528 (28.6)	Ref.	186 (28.2)	Ref.
Opposition parties	146 (26.1)	473 (25.6)	0.91 (0.67–1.22)	156 (23.6)	**0.70 (0.49–1.00)**
Governing parties	251 (44.9)	847 (45.8)	0.92 (0.71–1.19)	318 (48.2)	0.88 (0.64–1.20)
Participation at religious meetings					
At least once a month	97 (17.3)	223 (12.1)	Ref.	95 (14.4)	Ref.
Less than once a month	62 (11.1)	311 (16.8)	**1.79 (1.22–2.62)**	97 (14.7)	1.34 (0.85–2.13)
Never, or almost never	400 (71.6)	1314 (71.1)	1.16 (0.86–1.55)	468 (70.9)	0.98 (0.69–1.39)
Contact with a close person (except kids)					
Less than once a week	88 (15.7)	170 (9.2)	Ref.	50 (7.6)	Ref.
At least once a week	118 (21.1)	350 (18.9)	1.37 (0.96–1.95)	97 (14.7)	1.29 (0.81–2.07)
Daily	353 (63.2)	1328 (71.9)	**1.62 (1.18–2.23)**	513 (77.7)	**2.03 (1.34–3.08)**
In conversations I consider myself a:					
"No, but…" type	171 (30.6)	506 (27.4)	Ref.	187 (28.3)	Ref.
"Yes, and…" type	388 (69.4)	1342 (72.6)	1.07 (0.85–1.33)	473 (71.7)	0.96 (0.73–1.25)
Optimism [1,3]			0.98 (0.94–1.01)		**0.97 (0.93–1.00)**
Interpersonal trust [1,4]			0.96 (0.83–1.10)		**0.72 (0.61–0.85)**
Empathy [1,5]			1.00 (0.98–1.02)		1.01 (0.98–1.04)
Tendency to consider multiple perspectives [1,5]			1.01 (0.99–1.03)		1.02 (0.99–1.05)
Conscientiousness [1,6]			1.03 (0.99–1.07)		1.11 (1.06–1.16)

Table 4. *Cont.*

	Do Rather Not or Not at All Agree (N = 559)	Rather Agree (N = 1848)	Fully Agree (N = 660)
Extroversion [1,6]		1.03 (0.99–1.06)	1.04 (1.00–1.08)
Agreeableness [1,6]		**1.04 (1.00–1.08)**	1.04 (0.99–1.09)
Openness [1,6]		0.98 (0.95–1.01)	1.00 (0.96–1.03)
Neuroticism [1,6]		**1.05 (1.01–1.08)**	**1.05 (1.01–1.09)**

Footnotes: [1] one unit increase [2] TKS-WLB [3] LOT-R [4] KUSIV3 [5] questionnaire for empathy and tendency to consider multiple perspectives (perspective taking), German version [6] BFI-S. Odds ratios (OR) and 95% confidence intervals (95%CI) are mutually adjusted for all other variables presented in the table.

In multivariable adjusted models, agreement with the statement "Complex real-world problems require the collaboration between scientists and practitioners in problem solving" correlated positively and significantly with higher age ($OR_{rather\ agree}$ = 1.03; 95%CI = 1.02–1.05; $OR_{fully\ agree}$ = 1.04; 95%CI, 1.03–1.06), being male, and residing in Austria. The odds of agreeing with this statement were also significantly higher among participants without a migration history (vs. first- or second-generation migrants), those with higher educational attainment (vs. lower educational attainment, $OR_{fully\ agree}$ = 1.59; 95%CI = 1.08–2.33; this finding supports H2), students (vs. full- or part-time employees), those with higher work satisfaction, and those who voted in the respective last national election (vs. non-voters; voters for the opposition, $OR_{fully\ agree}$ = 2.15; 95%CI, 1.41–3.28; voters for the governing party, $OR_{fully\ agree}$ = 1.73; 95%CI, 1.22–2.47). Higher agreement with the statement on the need for science–practice collaboration was also seen among those with lower frequency of participation in religious meetings and higher frequency of in-person social contact. Concerning personality characteristics, agreement strongly correlated with higher levels of interpersonal trust ($OR_{rather\ agree}$ = 1.31; 95%CI, 1.09–1.58; $OR_{fully\ agree}$ = 1.37; 95%CI, 1.12–1.66; Table 3; this finding supports H1), higher tendency to consider multiple perspectives ($OR_{rather\ agree}$ = 1.03; 95%CI, 1.00–1.06; $OR_{fully\ agree}$ = 1.06; 95%CI, 1.02–1.09; this finding supports H3), higher levels of conscientiousness ($OR_{rather\ agree}$ = 1.07; 95%CI, 1.02–1.12; $OR_{fully\ agree}$ = 1.14; 95%CI, 1.08–1.20) and higher levels of agreeableness ($OR_{fully\ agree}$ = 1.06; 95%CI, 1.00–1.12), but lower levels of extraversion ($OR_{rather\ agree}$ = 0.96, 95%CI, 0.94–0.99; $OR_{fully\ agree}$ = 0.94; 95%CI, 0.90–0.99; Table 3).

In line with the findings regarding the need for science–practice collaboration to address complex problems, agreement with the statement "I expect science to provide clear results" (rather or fully agree, average across Austria, Germany and Switzerland, 81.7%, this finding supports H4) correlated positively with higher age ($OR_{rather\ agree}$ = 1.02; 95%CI, 1.01–1.03; $OR_{fully\ agree}$ = 1.01, 95%CI, 1.00–1.02), being male, residing in Austria or Germany (this finding supports H5), and with higher satisfaction with work and higher frequency of in-person social contacts. By contrast, agreement with the statement "I expect science to provide clear results" correlated inversely with educational attainment ($OR_{fully\ agree}$ = 0.69; 95%CI, 0.51–0.93; Table 4), being self-employed, and having voted for an opposition party in the last elections compared to not having voted ($OR_{fully\ agree}$ = 0.70, 95%CI, 0.49–1.00; Table 4) (see also Figure 1 for the conceptual overview and correlates).

Concerning personality characteristics, agreement with the statement "I expect science to provide clear results" correlated inversely with higher levels of optimism ($OR_{fully\ agree}$ = 0.97, 0.93–1.00) and higher levels of interpersonal trust ($OR_{fully\ agree}$ = 0.72; 95%CI, 0.61–0.85). A positive correlation was found with higher levels of agreeableness ($OR_{rather\ agree}$ = 1.04; 95%CI, 1.00–1.08, $OR_{fully\ agree}$ = 1.04, 95%CI, 0.99–1.09) and neuroticism ($OR_{rather\ agree}$ = 1.05; 95%CI, 1.01–1.08; $OR_{fully\ agree}$ = 1.05; 95%CI, 1.01–1.09; Table 4).

4.3. Hypothesis Testing

Overall, the results of the multivariable models (Section 4.2) largely support the pre-specified hypotheses: Higher levels of interpersonal trust (H1), educational attainment

(H2), and perspective-taking (H3) were positively correlated with recognizing the need for science–practice knowledge co-production. In line with H4, a more linear epistemic orientation—reflected in the expectation that science provides clear results—was inversely related to the recognition of co-production. Furthermore, differences across countries support H5, indicating that institutional context plays a role in forming public perceptions. Taken together, these findings confirm that both cognitive and contextual factors contribute to the recognition of science–practice collaboration in complex societal settings.

4.4. Additional Findings

In addition to the pre-specified hypothesis-driven analyses, exploratory analyses identified several additional factors associated with recognition of science–practice collaboration. These findings should be interpreted with caution, as they were not specified a priori and require confirmation in future studies.

4.5. Summary of Findings

Taken together, the results suggest that recognition of science–practice knowledge co-production is shaped by a combination of:

- interpersonal and cognitive factors (trust, perspective-taking),
- structural factors (education), and
- contextual influences (institutional setting).

These findings are consistent with our conceptual framework and support the relevance of science–practice knowledge co-production for addressing complex societal challenges.

5. Discussion

Overall, our findings largely support the theoretically derived hypotheses and provide important insights into the interpersonal, cognitive, and institutional conditions shaping public recognition of science–practice knowledge co-production. The study thereby contributes to understanding how public perceptions of collaborative knowledge integration emerge within complex societal systems characterized by uncertainty, interdependence, and multiple forms of expertise. The results thereby extend existing work on transdisciplinary collaboration and systems-oriented knowledge integration by empirically showing that trust, educational attainment, perspective-taking, and institutional context may influence public recognition of collaborative knowledge production in complex societal systems. A large majority of respondents acknowledged that complex societal challenges require collaboration between scientists and practitioners, indicating broad societal recognition of co-productive knowledge processes. From a systems perspective, this recognition can be interpreted as an enabling condition for effective knowledge integration. In complex adaptive systems, where knowledge is distributed and uncertainty remains high, the capacity to co-produce and integrate knowledge across domains is essential for innovation and adaptive governance [6,7,19,31].

5.1. Interpretation of Hypothesis-Driven Findings

In our three-country survey among 3067 participants of the Central-European D-A-CH region, we identified overwhelming recognition (90.1% rather agreed, n = 1595; or fully agreed, n = 1169) and acceptance of the notion that science–practice collaboration is needed to address complex societal challenges. Main correlates of acceptance of science–practice collaboration in our analyses were interpersonal trust, and demographic factors such as age, gender, residence, or migration status. In addition, education, and several personality characteristics were correlated with the expectation of science–practice collaboration to address complex societal challenges.

Our findings complement and extend previous research. For example, a special Eurobarometer survey on European citizen's knowledge and attitudes towards science and technology across publics from 20 different countries conducted in April and May 2021 shows that 78% of all respondents agree that science and technology should consider the needs of all groups of people when developing new solutions and products [26].

The positive association between interpersonal trust and recognition of science–practice knowledge co-production strongly supports H1 and reinforces the assumption that interpersonal trust constitutes a foundational enabling condition for collaborative knowledge integration across institutional and epistemic boundaries. Low interpersonal trust was one of the strongest correlates for not recognizing the importance of science–practice knowledge co-production. From a systems perspective, trust reduces perceived uncertainty in complex interactions and facilitates cooperation among heterogeneous actors involved in collective problem-solving processes.

The strong association between interpersonal trust and recognition of the need of knowledge co-production highlights the importance of relational factors. Trust enables engagement with diverse knowledge sources and supports openness toward collaborative knowledge processes [21,22,24]. We found that levels of interpersonal trust were lower among women, individuals who were less educated or had less income, and who had not voted during the last national election. By contrast, more optimistic, agreeable, extroverted people were more likely to exhibit stronger interpersonal trust in our sample [21]. Further studies that showed that trust has become a central focus during the COVID-19 pandemic: Algan et al. [36] surveyed trust in science, governments and others in 12 countries (France, Italy, USA, Australia, Brazil, Germany, UK, Canada, Poland, Sweden, Austria and New Zealand) as indicators to explain compliance with non-pharmaceutical interventions and willingness to get vaccinated during the first year of the COVID-19 pandemic. The authors concluded that trust in scientists was a crucial influence of people's willingness to comply with non-pharmaceutical interventions and to vaccinate. Other (non-peer reviewed) research indicates a general decline of reported trust in scientific information during the COVID-19 pandemic [46,47].

At the same time, the role of education and perspective-taking suggests that cognitive and social capacities are crucial for fostering a systemic understanding of knowledge production [31]. Such capacities enable individuals to move beyond linear expectations of science toward more integrated and participatory models of knowledge generation.

Consistent with H2, higher educational attainment was positively associated with recognition of the need for science–practice knowledge co-production. The role of education is particularly relevant here as education can be influenced by political measures. This supports prior research indicating that higher education may foster systems thinking, reflexive reasoning, and the capacity to engage with uncertainty and multiple forms of knowledge [12,13]. Our findings suggest that societies whose education systems emphasize the role of science–practice collaboration in the context of broader societal decision-making may be better equipped to deal with current and future challenges.

The observed association between perspective-taking and support for science–practice collaboration further supports H3 and underscores the importance of cognitive openness, reflexivity, and the capacity to integrate heterogeneous perspectives within complex systems. From a systems perspective, the capacity to consider multiple perspectives represents a key enabling condition for integrating heterogeneous forms of knowledge across institutional and epistemic boundaries. As a key characteristic of the transdisciplinary approach, science–practice collaborations function as mutual learning processes that facilitate the integration

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of knowledge and expertise from diverse disciplines and fields of practice. By bringing together actors with different ways of knowing, expertise, and mindsets (interpersonal), these collaborations rely heavily on trust for their effective functioning [21,48].

The findings regarding expectations that science should provide clear results partially support H4 and point toward an important epistemic tension. While respondents strongly endorsed science–practice collaboration, many simultaneously expected science to generate clear and definitive answers, reflecting a comparatively linear understanding of knowledge production. This coexistence suggests that public recognition of collaborative knowledge production does not necessarily imply recognition of the uncertainty, ambiguity, and iterative learning processes characteristic of complex adaptive systems and post-normal science. The findings therefore resonate with STS and post-normal science perspectives emphasizing that knowledge in complex societal crises is provisional, context-dependent, and shaped through iterative interactions among scientific and societal actors [14,16]. From a systems perspective, effective science–practice knowledge co-production requires not only collaboration across domains, but also public acceptance of uncertainty, plurality of perspectives, and adaptive learning processes.

Beyond individual-level cognitive and interpersonal factors, the findings also indicate that broader institutional and governance contexts shape public orientations toward science–practice collaboration.

The observed cross-country differences provide partial support for H5 and suggest that institutional and cultural contexts shape public orientations toward science–practice collaboration. Although the D-A-CH countries share linguistic and historical similarities, they differ in political culture, institutional trust, science–policy traditions, and public communication structures. The observed differences between Austria, Germany, and Switzerland may reflect historically distinct science–policy cultures and institutional configurations. Switzerland's stronger tradition of decentralized governance and direct democratic participation may foster more pluralistic expectations toward scientific expertise, whereas Germany and Austria historically exhibit somewhat stronger expectations toward institutionalized expert systems and centralized scientific authority. Such differences align with STS perspectives emphasizing that public perceptions of science are shaped by culturally embedded institutional arrangements and political traditions [16,33,34]. These contextual differences may influence how individuals perceive the legitimacy, authority, and societal role of science, as well as expectations regarding science–practice interaction and knowledge co-production within broader governance systems [49].

Taken together, the findings indicate that recognition of science–practice knowledge co-production is not solely an individual attitude but is embedded within broader systems of trust, learning, institutional legitimacy, and collaborative governance. The supported hypotheses collectively suggest that public recognition of collaborative knowledge integration emerges through interactions between interpersonal, cognitive, and institutional conditions. The relevance of science–practice collaboration extends beyond questions of research and innovation. In increasingly complex societies, democratic governance depends on the capacity to integrate diverse forms of knowledge, experience, and perspectives into collectively actionable orientations. From this perspective, transdisciplinary collaboration can be understood not only as a research strategy but also as a societal mechanism that helps sustain the decision-making capacity of democratic systems in the face of complex societal challenges. In a nutshell, mutual learning between and the integration of the knowledge and experiences of scientists and multiple societal actors, such as practitioners, can serve consensus building, mediation, capacity building, and legitimization of science-based results to achieve social cohesion [7,36]. Trust in science is declining even further and conspiracy theories are finding a breeding ground in society.

The results presented provide important insights into the factors that may help leverage the widespread societal recognition of the need for science–practice collaboration. This matters especially for research aiming to understand complex societal challenges and delineate socially robust orientations by acknowledging scientists' responsibility for global futures [49].

These findings are also relevant forsystems-oriented knowledge management, organizational learning, and institutional innovation processes. Organizations operating in complex environments increasingly depend on integrating external knowledge and engaging with stakeholders. Public recognition of the need for science–practice knowledge co-production may therefore facilitate the implementation of collaborative and innovation-oriented strategies.

5.2. Strengths and Limitations

Strengths of our analysis include the large sample size across the D-A-CH region and the broad range of demographic, lifestyle, and personality-related variables assessed. However, some limitations also deserve note. The study captures public recognition of the need for science–practice knowledge co-production rather than direct participation in such processes; moreoever, the use of single-item measures simplifies inherently complex constructs such as knowledge co-production. As the study employed quota sampling, representativeness cannot be formally guaranteed, and the findings may be subject to selection bias. Although quota sampling approximates key sociodemographic characteristics, the absence of response rate information and potential selection biases should be considered when interpreting the results. In addition, the cross-sectional design precludes causal inference. The findings should therefore be interpreted as descriptive and analytically informative within the sampled population, and not as statistically representative population-level estimates. Accordingly, the findings should be interpreted as evidence of theoretically informed correlations rather than causal confirmation of the proposed mechanisms.

5.3. Conclusions

The findings of our study provide a comprehensive overview of public perceptions towards partnerships between scientific actors and actors from practice in the D-A-CH region. A substantial majority supports the idea that addressing complex societal challenges requires enhanced collaboration between actors from both science and practice.

We not only show that public recognition of the need for science–practice knowledge co-production is widespread, but also that it is systematically structured by factors such as trust, education, and perspective-taking. From a systems perspective, such recognition represents a key enabling condition for knowledge integration, organizational learning, and innovation. Developing system-level understanding and scenario-based thinking forms the foundation for collaborative, solution-oriented processes that support informed policy interventions, democratic decision-making, and sustainability-oriented system innovations [50].

Educational efforts to strengthen cooperation between science and practice must go beyond formal higher education. They should be embedded within a lifelong learning framework that provides individuals with opportunities for continuous education and skills development throughout different stages of life. Competences that support transdisciplinary collaboration—as a foundation for evidence-informed policy and decision-making in complex real-world contexts—are developed and refined not only through formal educational interventions but also within participatory, practice-oriented settings [14,15]. This underscores the need for educational systems at all levels to adapt in ways that enable societies to address complex societal challenges through strengthened science–practice collaboration.

In summary, the findings suggest that strengthening systems-oriented education and training, public engagement, and institutional trust may support broader societal recognition of science–practice knowledge co-production in addressing complex societal challenges.

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Informed Consent Statement: Participation was voluntary, and informed consent was implied through completion of the online survey. No formal vote of an ethics committee was required.

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