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Application of Q-methodology for identifying factors of acceptance of spatial planning instruments

Manuel Sudau*, Enrico Celio and Adrienne Grêt-Regamey

ETH Zurich, Planning of Landscape and Urban Systems (PLUS), Institute for Spatial and Landscape Development, Zurich, Switzerland

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Worldwide, urbanization leads to increased pressure on prime agricultural land with irreversible impacts on the provision of life-supporting services such as food and drinking water production or habitat for plants and animals. As a basis for designing new policy instruments to protect soil resources, we applied Q-methodology to assess factors that influence the acceptance or rejection of such instruments. Using an online survey and interviews, we identified different social perspectives and their respective argumentation patterns. The results show that effect on people, institutional embeddedness, trust in the acting institutions, and the overall understanding of the instrument are the most important factors for the acceptance of policy instruments fostering the sustainable use of soil resources. During the interviews, idealistic and fact-based arguments were more important than person-based arguments. Based on our results, communication strategies in the policy-making process can be improved and tailored to the identified characteristics of the social perspectives.

Keywords: acceptance; acceptance factors; Q-methodology; spatial planning; policy-making

Highlights

- For a spatial planning instrument to be accepted, it must be perceived as fair in terms of costs and benefits, and having a moderate impact on the people.
- Understanding the functionality, representation and credibility of a spatial planning instrument is essential to secure people's institutional trust in a policy.
- When people are directly affected by a spatial planning instrument, or perceive it as negative or unfair, this can override other acceptance factors, and lead to rejection.
- In surveys, person-based arguments are more important for acceptance than idealistic and fact-based arguments; during face-to-face interviews, the reverse is true.

1. Introduction

Worldwide, urbanization leads to strong pressures on the best land with irreversible impacts on the provision of life-supporting services such as food production, clean

*Corresponding author. Email: sudaum@ethz.ch

water for drinking, flood mitigation, and habitat for plants and animals (e.g. Blum 2005; EC 2006; FAO 2015). Spatial planning has the task to coordinate all activities with spatial impacts and to manage the multiple and collective interests from different stakeholders for resources such as air, water and soil (cf. VLP ASPAN 2012; Pleger 2017). Most spatial planning instruments focus, however, on steering the amount of hectares lost to urbanization (cf. Fertner *et al.* 2016), rarely considering soil quality and the related multiple, and often diverging claims for such resources (VLP ASPAN (Swiss Planning Association) 2012; Drobnik *et al.* 2018). A better knowledge of factors for acceptance or rejection of policy instruments conserving soil quality, such as e.g. fees on soil quality, would thus be useful for designing effective spatial planning instruments to be accepted amongst the relevant actors (e.g. public, local stakeholders, policy-makers, government offices).

In fact, publicly rejected policies or projects can lead to temporal delays, stagnation, financial overruns, or other uncertainties (cf. Devine-Wright 2011). In contrast, acceptance can develop during a dynamic decision-making process and can enable or promote the application of the object of acceptance. Acceptance describes the act of accepting something (Collins 2000, as quoted in Batel, Devine-Wright, and Tangeland 2013, 2) or affirmatively responding to something (Batel, Devine-Wright, and Tangeland 2013, 2; Huijts, Molin, and Steg 2012). Acceptance is behavioral and might change over time, e.g. someone may have once accepted something but may have changed that opinion over time. It can be understood as a non-permanent, dynamic process of opinion-making (cf. Kollmann 1996, 64, as quoted in Quiring 2006, 5). While acceptance is a behavioral action, *acceptability* describes the attitudes and opinions by someone concerning the object of acceptance (Gärling and Loukopoulos 2007; Huijts, Molin, and Steg 2012; Dermont *et al.* 2017). To structure research on acceptance, Schade and Schlag (2003) suggest questioning acceptance of *what*, *through whom*, and *under which conditions*. These questions were operationalized in the frame of land use policy measures by Pleger (2017). The *what* is attributed to policies, instruments, or scenarios. The *through whom* describes the individual characteristics of the subject of interest, e.g. experiences and beliefs as well as preferences and attitudes (Pleger 2017; cf. Schade and Schlag 2003). The *under which condition* reflects external factors which might influence acceptance, e.g. economic context, thematic framework, spatial level, or the type of a policy instrument (Pleger 2017; cf. Wüstenhagen, Wolsink, and Bürer 2007).

Research on acceptance factors has focused on various objects of acceptance (*what*). In the field of marketing, Quiring (2006), for example, investigated the role of acceptance factors for introducing new communication standards and Rogers (2003) for the adoption of innovation. In research on policy, Keohane, Revesz, and Stavins (1998) investigated the choice of regulatory instruments in environmental policy, Cotton and Mahroos-Alsaiari (2015) analyzed key actor perspectives in environmental impact assessment, Curry, Barry, and McClenaghan (2013) did research on stakeholder views on environmental and resource dimensions of sustainability, and Pleger (2017) investigated the acceptance of land use policies. Carter and Bélanger (2005) explored acceptance factors for the utilization of e-government services, and Schade and Schlag (2003) and Schlag and Teubel (1997) for transport policy and road pricing. In spatial planning-related research, studies can be found on the acceptance of wind energy (Lienhoop 2018; Huijts, Molin, and Steg 2012; Devine-Wright 2005, 2011;

Wüstenhagen, Wolsink, and Bürer 2007; Langer *et al.* 2018), and renewable energy in general (cf. Ho *et al.* 2019).

Acceptance is also highly dependent on factors related to the subject of acceptance (*through whom*), such as trust (Huijts, Molin, and Steg 2012; Cotton and Mahroos-Alsaiari 2015) and information (Rogers 2003; Schlag and Teubel 1997; Petrova 2016), perceived input-outcome (Schlag and Teubel 1997, Huijts, Molin, and Steg 2012; Langer *et al.* 2016; Rogers 2003), affectedness (Schade and Schlag 2003; Wüstenhagen, Wolsink, and Bürer 2007; Pleger 2017; Michaud, Carlisle, and Smith 2008), effectiveness (Gärling and Loukopoulos 2007; Schlag and Teubel 1997), justice, equality (Walter 2014; Langer *et al.* 2018), as well as fairness and equity (Huijts, Molin, and Steg 2012; Schlag and Teubel 1997). Furthermore, it is known, that the proximity of a policy (cf. Pleger 2017) influences its acceptance. The proximity of a policy (Soss and Schram 2007; cf. Pleger 2017) describes how directly a policy affects individuals. Regulations (e.g. a zoning plan), taxes, or quality of life in an urban or suburban environment are affecting individuals directly and enable them to evaluate a spatial planning policy better than more distant ones (Soss and Schram 2007; Pleger 2017), e.g. environmental policies such as the Swiss energy strategy 2050.

Most of the studies have used surveys to assess the relevance of factors that impact acceptance and non-acceptance. The resulting data is mostly evaluated using regression or correlation analyses to identify and relate acceptance factors (cf. Schade and Schlag 2003; Langer *et al.* 2018, Zabala, Sandbrook, and Mukherjee 2018). It has been criticized that participants in these studies might be constrained by the interpretation of scales and could not express their subjective opinion adequately (e.g. Likert-scale from 1 to 5; absolutely unacceptable to totally acceptable) (McKeown and Thomas 2013; Müller and Kals 2004). Furthermore, results from interviews and qualitative descriptive analyses (cf. Hootman 1992) might not be generalizable (Webler, Danielson, and Tuler 2009) and those findings about acceptance are thus of rather descriptive than explanatory character (cf. Webler, Danielson, and Tuler 2009). Several authors have, therefore, called for methods that critically engage with a deeper understanding of acceptance (Devine-Wright 2005; Ellis, Barry, and Robinson 2007; Upham and Pérez 2015).

Q-methodology was developed in the 1930s and is a qualitative method, that uses the statistical techniques of correlation and factor analysis for analysis. The results are expressed in *social perspectives* and are interpreted to find consensus and dissent between the perspectives (Webler, Danielson, and Tuler 2009). The method links traditional and post-positivist approaches of policy research (cf. Ellis, Barry, and Robinson 2007) and holds the potential to explore the discourse of public support and objection. The subjectivity or *concourse* of a topic is pictured with *typical* statements. This set of statements (Q-set) describes the numerous perspectives of the concourse (Brown 1980; Müller and Kals 2004). Participants of a Q-study are forced to rank each statement in relation to the other statements, usually within a forced distribution (Webler, Danielson, and Tuler 2009). The sorted sets of statements (Q-sorts) are comparable because the same statements are sorted by each participant. Q-methodology is thus self-referential and used in order to understand an individual's subjective perspective concerning a subject. A Q-sort can be considered to form a participant's opinion on a subject of research (Webler, Danielson, and Tuler 2009; cf. Brown 1980; cf. Armatas 2012). The Q-sorts of all participants of a Q-study can be statistically correlated (Q-correlation), and factors (Q-factors) can be formed that have significantly different characteristics, and which represent different social perspectives on the object of research. These Q-factors can help to understand the character of friction and opinions by analyzing similarities (consensus), differences (confrontation), or uncertainties across the different Q-factors and their respective characteristic Q-sort. Q-methodology reveals the cognitive logic behind an argumentation and uncovers patterns across Q-sets sorted by individuals rather than across traits of individuals (cf. Devine-Wright 2005; Webler, Danielson, and Tuler 2009). As opposed to R-methodology, which investigates how participants answer questions, Q-methodology investigates statements that are sorted by participants, and the whole set of statements as ordered by each participant is further analyzed in a holistic way. The method helps in understanding and clarifying individual opinions while merging these to comprehensible contexts and public perspectives (cf. Webler, Danielson, and Tuler 2009; Zabala, Sandbrook, and Mukherjee 2018). Thus, Q-methodology works with rather small numbers of participants, as it aims to identify key viewpoints with regard to the concourse (McKeown and Thomas 2013; Webler, Danielson, and Tuler 2009; cf. Zabala, Sandbrook, and Mukherjee 2018).

In this contribution, we use Q-methodology to identify the relevance of various acceptance factors for our study participants to accept or reject spatial planning instruments managing soil quality. We apply the method in an online survey as well as in face-to-face interviews and assess the respective differences between the acceptance factors. Participants were exposed to three scenarios illustrating the impact of various spatial planning instruments on soil quality. The survey harnessed a current discourse in Switzerland, in which a new policy to protect and manage the soil quality outside of building zones is being designed (Zelger *et al.* forthcoming). The results shed light on why these spatial planning instruments are accepted or rejected and ultimately provide new knowledge for policy-makers on how to design such instruments that manage soil and that are more accepted.

2. Materials, methods and study procedure

The workflow included three main steps, with (1) a literature search on acceptance factors to identify the main acceptance and rejection factors to be included in the survey, (2) the development of three scenarios illustrating the impacts of spatial planning instruments on soil quality using a land use model, and finally (3) the application of the Q-methodology using the three scenarios in an online survey and interviews to understand changes in argumentation patterns during an online survey and interviews as a basis for designing a new policy. A schematic representation of the workflow is provided in Figure 1.

2.1. Factors of acceptance

We defined five relevant acceptance factors based on the literature (Table 1 and more details in Table A.1 [online supplementary material]) and feedback from experts in spatial planning and the project team. On the one hand, we merged acceptance factors with different designations but similar meanings, e.g. fairness and equity, justice and equality, effectivity and perceived effectiveness. On the other hand, we bundled such acceptance factors whose definitions are closely related, e.g. institutional trust and political feasibility, efficiency, effectivity, and relative advantage, social and distributive justice and perceived unfairness and fairness.

Similar to these five acceptance factors, we also iteratively formulated the respective describing statements based on the feedback from four pretests with an external

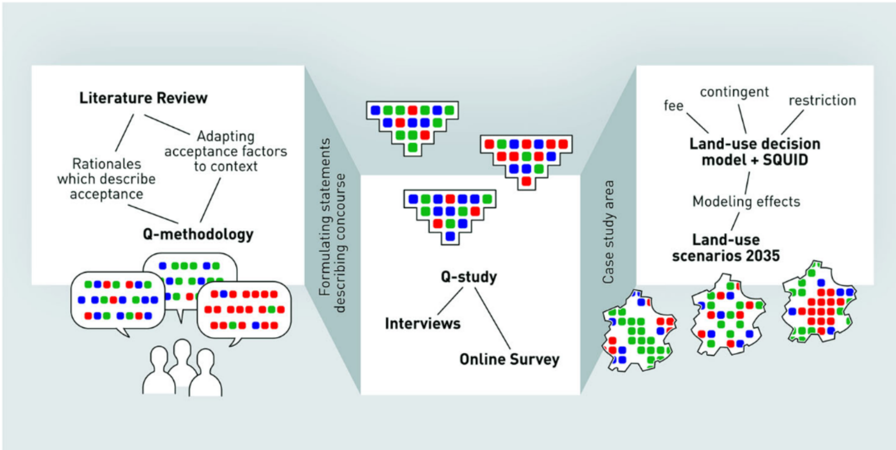

Figure 1. Structure of the research.

online panel (representative of the Swiss population) and with experts in spatial planning. The statements refer to specific aspects of the instruments, such as how efficient it is perceived to achieve its defined goal or whether the functioning of an instrument is understood, or whether an instrument is perceived as compatible with existing policy instruments. Based on the definitions and descriptions of the acceptance factors presented in Table A.1 (online supplementary material), we assigned each of the statements to one of the five acceptance factors and validated this assignment iteratively in the third and fourth pretest as well as in discussions within our project team, and revised it according to the feedback. Table 1 documents each of the acceptance factors gathered from the literature and how we combined them into the following five acceptance factors we propose. In this regard, the *design of the instrument* bundles acceptance factors from the literature that are related to the design variables of the instrument, for instance, its type and cost. The *effect on people* bundles acceptance factors that describe the perceived individual affectedness of a person by the instrument, such as whether they would be directly affected by taxes or restrictions as a landowner. *Institutional embeddedness* bundles acceptance factors such as the perceived compatibility with existing spatial planning instruments, the necessity of a new instrument with the purpose of managing soil, and the trust in acting institutions. *Effect of the instrument* refers to acceptance factors from the literature that consider the efficiency, effectiveness, or relative advantage of the instrument in relation to its objective of managing soil. Finally, the *understanding of the instrument* bundles acceptance factors that relate to the basic understanding of the instrument in terms of its functioning or effect. Table A.1 (online supplementary material) describes in detail each of the definitions used in the literature.

2.2. *Case study area*

In Switzerland, roughly 3,500 hectares of productive land are lost every year (FSO 2020a), and between 1982 and 2015, 5.4% of the cultivated land was sealed. 80% of the sealed land was transformed into settlement area (FSO 2019), with irreversible loss

Table 1. Definition of acceptance factors used in this study (extension, s. Table A.1 [online supplementary material]).

Acceptance factors, derived from the literature (see Table A.1 [online supplementary material] for expansion)	Acceptance factors used in our study	Description
Revenue allocation; financial participation; proximity; coerciveness	Design of the Instrument	This acceptance factor describes all the designing variables of an instrument, such as its type, its costs and intended benefits, or its scope of application.
Equity; distributive justice; fairness/equity; justice/equality; individual affection; concerns; social justice; perceived unfairness; perceived threats toward freedom of choice	Effect on People	This acceptance factor describes the perceived individual affectedness of a person by an instrument and whether the possible impacts are perceived as fair and proportionate, measured by one's own concerns, perceived threats or personal attitudes.
Compatibility; institutional trust; political feasibility	Institutional Embeddedness	This acceptance factor describes the basic institutional trust toward an instrument and whether it is perceived as necessary, compatible with existing political frameworks and feasible.
Efficiency; relative advantage; effectivity; perceived effectiveness	Effect of the Instrument	This acceptance factor describes the perceived efficiency and effectiveness, and relative advantage of an instrument in relation to its purpose and in comparison to a business-as-usual scenario.
Complexity; evaluation; observability; information; value of information	Understanding of the Instrument	This acceptance factor describes the basic understanding of an instrument, in terms of how it works, how it is presented, and the credibility of the effects modeled.

of soil quality. A further growing population and steadily increasing pressure on urban residential landscapes are equally expected for Switzerland and the canton of Zurich by 2050 (ZH (Canton of Zurich) 2019, 2020). According to the spatial planning concept of the canton of Zurich (a strategic plan, binding on the authorities and defining the spatial development priorities of the canton), the areas designated as *urban residential landscapes* are intended to accommodate 80% of the forecasted population growth (ZH (Canton of Zurich) 2019). The canton of Zurich also defines so-called *landscapes under pressure*. Particularly their rural characteristics might change into more urban residential characteristics due to the quantity of additional population to be absorbed (ZH (Canton of Zurich) 2019). The draft policy *Bauen ausserhalb der Bauzonen* (BaB, building outside of building zones) aims at supporting this spatial development process by specifying the regulations under which buildings can be built outside of building zones and when and how they can be modified and used. The whole process of developing this policy is characterized by opposition and non-acceptance of several actors

Table 2. Modeled effects of the three spatial planning instruments on consumed area and soil quality compared to a business-as-usual scenario.

		Illnau-Effretikon	Volketswil	Bubikon/Wolfhausen	Gossau	Gruningen	Oetwil am See	Fehraltorf	Egg	Moenchaltorf	Uster	Average
Instrument 1	Effect on build area	−6.7%	−6.3%	—	−9.1%	—	—	—	−12.5%	—	—	−8.7%
	Effect on used soil quality	−8.2%	−6.4%	−0.6%	−13.7%	−1.0%	−2.8%	−2.0%	−14.2%	−11.5%	−0.6%	−6.1%
Instrument 2	Effect on build area	−20.0%	−25.0%	−30.0%	−25.0%	−20.0%	−20.0%	−20.0%	−25.0%	−25.0%	−22.0%	−23.2%
	Effect on used soil quality	−20.6%	−24.2%	−32.0%	−32.1%	−33.3%	−34.7%	−23.4%	−32.8%	−40.0%	−22.3%	−29.5%
Instrument 3	Effect on build area	—	−12.5%	—	−9.1%	—	−40.0%	—	—	—	−11.0%	−18.2%
	Effect on used soil quality	−4.6%	−5.3%	−10.9%	−24.1%	−13.8%	−50.0%	−5.9%	−15.6%	−23.9%	−4.4%	−15.9%

Table 3. Overview of survey administration.

ID	Name	Population	Invitations distributed	Ratio: population/ invitations	Participants (total)	Ratio: participants/ invitations
3	Bubikon/ Wolfhausen	7,003	950	14%	59	6%
4	Gossau ZH	9,789	1,325	14%	45	3%
5	Gruningen	3,411	450	13%	25	6%
6	Oetwil am See	4,639	625	13%	20	3%
7	Fehraltorf	6,334	850	13%	45	5%
1	Illnau-Effretikon	16,364	2,200	13%	99	5%
8	Egg	8,399	1,125	13%	34	3%
9	Moenchaltorf	3,647	500	14%	32	6%
10	Uster	33,686	4,525	13%	84	2%
2	Volketswil	18,515	2,475	13%	53	2%
	Sum	111,787	15,025	13%	496	3%

(Zelger *et al.* forthcoming) and it is difficult to find a common ground amongst all involved actors.

The case study area is categorized as urban residential landscape and landscape under pressure, according to the cantonal spatial planning concept (ZH (Canton of Zurich) 2019), and is located east of the Greifensee in the canton of Zurich. The ten municipalities that form the case study area are located in the metropolitan region of Zurich and cover a total area of about 144 km^2, well connected to Zurich's city center and international airport. The case study area is home to more than 110,000 inhabitants (Table 3 and Figure 2) and a future population growth by approximately 30% is expected, with roughly 33,000 additional inhabitants by 2050 (ZH (Canton of Zurich) 2020).

2.3. *Scenarios development*

To understand the effects of new spatial planning instruments on the loss of soil quality, we ran a land use allocation model developed by Schwaab *et al.* (2017) under different configurations. Each of the three instruments was modeled as a scenario. These scenarios can be compared among each other as well as with a baseline scenario, which was modeled under business-as-usual conditions. The land use allocation model was extended by a soil quality index to allow calculation of the effects of each instrument on the consumption of soil quality. Several authors developed approaches to make the multiple services of soil more explicit and to enable spatial planning to use soil quality as an indicator for spatial decisions. Greiner *et al.* (2017), for instance, assessed soil functionalities using pedotransfer functions. Drobnik *et al.* (2018) combined data on soil functions and the soil's ability to support ecosystem services and hence established a soil quality indicator (SQUID). The SQUID data by Drobnik *et al.* (2018) was available for the case study area we used. A cantonal scenario (cf. FSO 2020b) for the future population growth of each of the municipalities drove the demand for new settlement areas. Around 75% of this demand was absorbed within the existing settlement area, mainly by the given reserves of the municipalities, and

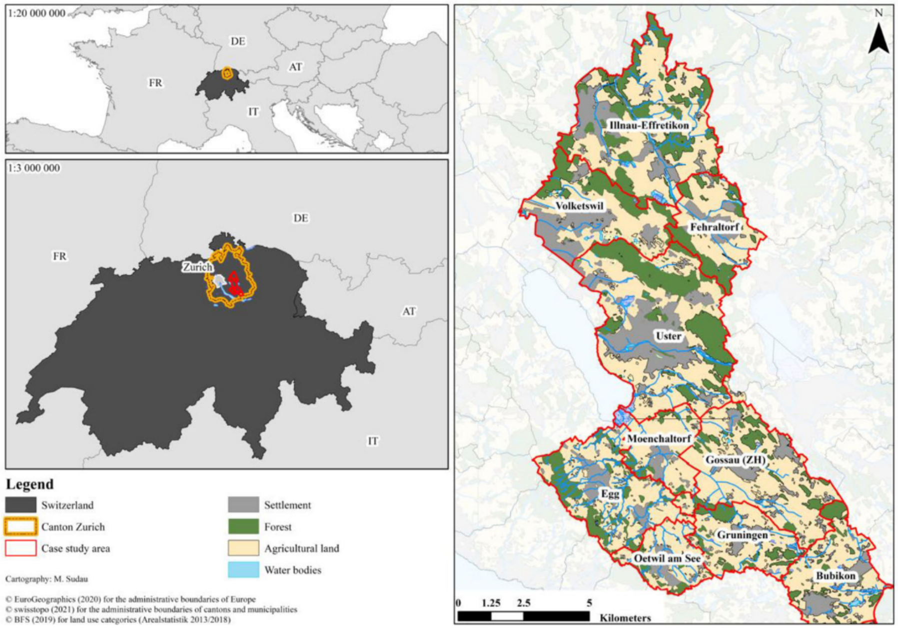

Figure 2. Case study area in the metropolitan region of Zurich (Switzerland), encompassing ten municipalities with ca. 110,000 inhabitants and covering a total area of 144 km^2.

around 25% of the demand drove green field development. The model stochastically allocated the choice of the patches to be built, their size, and their population density, based on the probabilities derived from the past settlement development (cf. Cohen 2016).

Three different spatial planning instruments were implemented into the model: (1) fee on soil quality, (2) quota of soil quality, and (3) restriction for high soil quality areas, and the results were compared to a business-as-usual scenario. All scenarios were run for the year 2035 at a 100 × 100 m raster cells resolution.

- *Fee on soil quality*

The idea behind this instrument is that landowners have to pay an additional fee for the soil quality of the land to be developed. The higher the soil quality, which is evaluated with the SQUID indicator, the higher the amount of the fee. The fee has to be paid additionally to the construction costs and, if necessary, the land price. Thus, the fee increases the costs for landowners if they want to build on agricultural land, and might encourage them to develop inside the existing settlement area. This shift of demand was modeled by the land use allocation model and is determined by the price elasticity of demand for land. This parameter was calculated and adjusted in the work by Cohen (2016).

- *Quota of soil quality*

This instrument focuses on a quota of soil quality points for each municipality, determined by the canton (cf. Estermann 2016). Soil quality points can be considered as a scalable unit representing the sum of soil functions at a certain area. If the soil quality points are subject to a quota regulated through a spatial planning instrument, the spatially explicit decisions can be made, for example, on the basis of the difference in points between the actual and target state or the ratio between the amount of land converted and soil quality points lost (cf. Grêt-Regamey *et al.* 2018). The German city of Stuttgart, for example, regulates its municipal soil management with such an instrument (cf. Wolff 2006). In our model, we set the quota for each municipality to 20% of the existing soil quality points. If the quota was exploited, additional demand for residential use was allocated to within the existing settlement area and the consumption of additional non-residential area was restricted.

- *Restriction for high soil quality areas*

The idea behind this instrument is to simply restrict settlement development on those areas with the highest soil quality. 60% of non-settlement area with the highest soil quality were selected for each municipality and excluded from the allocation of the settlement demand.

The changes in the settlement expansion, and thus the loss of soil quality, were modeled for each municipality in a spatially explicit manner, compared to a baseline scenario and presented to the participants as maps. The interactive map enabled participants to see where and how the instrument changed the settlement development in their municipality. Furthermore, model results such as the loss of soil quality or difference in built settlement area between the scenarios were presented as short facts and for the participants' respective municipality only (Table 2). Based on the modeling, instrument 2 was the most effective overall. Instruments 1 and 3 did not have any effect on the built-up area in some municipalities. This is due to the fact that both instruments distribute the demand for new settlement area in these municipalities to less accessible land. Cohen (2016) assumes that existing land use plans limit allowable density the less centrally located an area is in a community. Such less accessible land can only accommodate low population densities. As a result, instruments 1 and 3 achieved little or no effect compared to the business-as-usual scenario, particularly in more rural municipalities.

2.4. Online survey: development, pretesting, and structure

An online survey (cf. Appendix B.2 [online supplementary material]) was developed and administered to 500 inhabitants in the case study area for identifying the factors influencing the acceptance or rejection of the three spatial planning instruments. We distributed invitation letters into private postboxes within the case study area, relative to the population of the respective municipality. The distribution of the letters followed specific routes through each municipality. The routes were created by covering heterogeneous quarters, blocks, and urban characteristics (type of housing, building age, e.g.) and using *Google Maps* and *Streetview* as well as on-site selection. In total, we distributed approximately 15,000 invitation letters (Table 3) throughout all municipalities of the case study area.

During the online survey, one of the instruments was randomly assigned to each participant in the study. In the first part of the online survey, participants were introduced to how the assigned instrument would work and how it would be implemented under existing regulations. Following this, each participant was able to view the modeled effects of the instrument and the baseline scenario within their municipality of residence on a map and in a table. After being introduced to each tool, participants could indicate whether they accepted or rejected the instrument shown. In the second part of the survey, participants had to do the Q-sorting exercise and place the statements to express each statement's un-/importance with regard to their acceptance or rejection of the instrument. The Q-sorting exercise was programmed using HTML- and PHP-scripts and participants could drag-and-drop the statements onto the pyramid (Figure B.1). To prevent ordering effects, the 23 statements were presented to the participants in a random order. In the last part of the online survey, participants had to answer socio-demographic questions.

2.5. *Interviews: participants, conduction, results, discussion*

To be able to better understand the level of acceptance and to validate the online survey results and gain in-depth knowledge, face-to-face interviews with participants of the online survey were conducted. Through one of the questions of the online survey, participants could voluntarily share their contact information if they were interested in being interviewed. The interviews were conducted a couple of months after the online survey. Participants had to analogously do the Q-sorting exercise from the online survey, followed by semi-structured interviews, which is common practice in Q-studies (cf. Armatas 2012; Webler, Danielson, and Tuler 2009). Ultimately, 17 participants agreed to be interviewed (Table B.2 [online supplementary material]).

2.6. *Q-Methodology*

We applied Q-methodology in our study, largely as described in the relevant literature (cf. Brown 1980; Zabala, Sandbrook, and Mukherjee 2018; Sneegas *et al.* 2021). Two-hundred and seventy-seven completed online surveys and 17 interviews were analyzed. The online survey sample was analyzed in two steps, (1) the complete sample ($N = 277$) and (2) two subsamples of those participants who accepted ($N = 214$) and rejected ($N = 63$) the spatial planning instruments. We conducted these two steps of analysis with the specific intention of obtaining an additional layer of information with which to compare and interpret the different idealized Q-sorts of each Q-factor (cf. Ward *et al.* 2017). In step 1, we considered the Q-sorts of all 277 participants. The goal was to gain insight into the statements that form an opinion about the various spatial planning instruments, regardless of their rejection or acceptance of the instrument in question and across all participants in our Q-study. In step 2, we analyzed whether and how the importance of the statements differed between participants who accepted an instrument and those who rejected it. The Q-analysis of the two subsamples allowed us to contrast and discuss the different importance of the statements for rejection or acceptance and interpret the identified social perspectives (Q-factors) more comprehensively. Based on the interview data, we first evaluated the findings of the online survey and ultimately analyzed the differences in participants' reasoning in the online survey and in the interviews (step 3) to gain further insights into our findings.

The Q-set consisted of 23 statements (cf. Appendix A.2 [online supplementary material]) that, based on the pretests, represent the concourse on the acceptance of spatial planning instruments that manage soil quality. The statements differ slightly in syntax and grammar according to acceptance and rejection as well as per instrument (cf. Table A.2 [online supplementary material]), which is necessary for readability reasons but does not affect the statements' messages. Whether this has effects on how the participants sorted the statements is discussed elsewhere in this paper. We assigned the 23 statements to one of the five previously defined acceptance factors. This assignment was not visible to the study participants and therefore did not interfere with the Q-study procedure. The primary purpose of doing so was to have an additional explorative layer of information available when interpreting the Q-analysis results later on, which allowed us to relate our results more directly to the literature in the field of acceptance.

A Q-factor is formed by grouping statistical significantly similar Q-sorts from participants in the online survey. For each Q-factor, a characteristic Q-sort can be derived, which represents a *group perspective* (Armatas 2012, 114) or a *social perspective* (Webler, Danielson, and Tuler 2009). We determined the number of Q-factors in the Q-analysis using the *Kaiser-criterion* or *Eigenwert-principle*, the *Cattel scree test* and *Horn's test of principal components* (UZH 2018; Dinno 2009; Fabrigar and Wegener 2012; Figure C.1 [online supplementary material]). Figure C.1 (online supplementary material) summarizes the partially divergent results of these tests, based on which we discussed, evaluated, and finally determined the number of Q-factors for our analysis. In this iterative process of consideration, we also incorporated our experience and qualitative feedback from interview participants (cf. Sneegas 2020; Sneegas *et al.* 2021).

After carefully determining the number of Q-factors, we decided to analyze two Q-factors for the complete sample ($N = 277$), one for the acceptance subsample ($N = 214$), and three for the rejection subsample ($N = 63$). The respective plots can be found in Appendix C.1 (online supplementary material). Table 4 gives an overview about the sample structure for the analysis and the number and size of the Q-factors for both steps of the analysis.

We used a pyramid with 23 fields (Figure B.1 [online supplementary material]) and a gradient from "very important" (+3) to "not important" (−3). The statements placed laterally are of *high saliency*, while statements in or near the middle are of *low saliency* to an argumentation (Brown 1980; Webler, Danielson, and Tuler 2009). The point, which separates statements of high and low saliency for the argumentation, is called *distinctive zero*. We statistically calculated the *distinctive zeros*, as well as the range of the average factor loading of a statement (Z-score, ZSC). The Z-scores have different ranges for each Q-factor and indicate the strength or saliency of the characteristic Q-sort itself as well as amongst all statements within the Q-sort. To improve the

Table 4. Sample structure and Q-factor analysis.

Analysis	Sample	No. of Q-factors for Q-factor analysis	No. of Q-sorts correlating with each Q-factor
Step 1	Complete sample ($N = 277$)	2 Q-factors	Factor 1: 89 Factor 2: 36
Step 2	Acceptance subsample ($N = 214$)	1 Q-factor	Factor 1: 95
	Rejection subsample ($N = 63$)	3 Q-factors	Factor 1: 15 Factor 2: 9 Factor 3: 10

interpretability of the Z-scores, we also calculated a normalized Z-score ($ZSC_{-1:1}$; range = [−1;1]), using the formula shown in Equation (1) . Here, *S* is the code of the respective statement and S_{ZSC} is the Z-score of statement *S*; *min ZSC* and *max ZSC* are the respective minimum and maximum Z-score values across all statements of the Q-set of *S*.

$$ZSC_{-1:1} = \frac{S_{zsc}}{(max\ ZSC) - (min\ ZSC)} \tag{1}$$

By transposing the dataset, the statements become subject to the analysis, while participants become variables (Webler, Danielson, and Tuler 2009). Participants in a Q-study are expected to respond to statements based on their own perception (Webler, Danielson, and Tuler 2009, 6). Every statement correlates with a Q-factor with a different weight. Thus, every Q-factor has its specific pattern of statements, where each statement has a certain Q-factor score, reflecting how much the statement correlates with the defined Q-factor. The Q-factor analysis uses the so-called *self-reference* of each statement to calculate the Q-factor loads (Brown 1980; Armatas 2012; Webler, Danielson, and Tuler 2009). We used the software *R for statistics* v3.1.3 and the software package *qmethod* to do the analysis.

3. Results

Table 5 illustrates the idealized Q-sorts of the six Q-factors from step 1 and 2 of the analysis. More details are available in Figure C.3 (online supplementary material), which is a suggestion for an alternative representation to Table 5, which can be discussed in the Q-community. We understand each of these Q-sorts as one unique social perspective why an instrument was rejected or accepted by the participants in our study. The respective normalized Z-score ($ZSC_{-1:1}$) of each statement indicates how strong it correlates with the Q-factor. Across all six Q-factors, the *effect on myself* (19) is the highest ranked statement except in one case, the pattern of Q-factor E of the rejection subsample, where it is ranked second. This finding was subject to specific questions in the interviews to investigate further. Another finding is that *power of municipality* (13) always plays an important role, as this statement is ranked $ZSC_{-1:1} \geq 0$ in five of the six Q-factors. In contrast *consumption of good quality soil* (15) mostly has no or a weak importance (always $ZSC_{-1:1} < 0.22$, negative in four Q-factors) for the argumentation.

Interestingly, Q-factors D and F of the rejection subsample use statements related to the acceptance factor *understanding of the instrument* (17, 21, 22, 23). The rejection is reasoned with a lack of understanding how the instrument works, how it is presented, or as how credible its modeled effects are perceived. However, this stands in contrast to the self-declaration, participants of the online survey stated *before* doing the Q-sorting exercise (Figure C.2 [online supplementary material]), and was subject to further investigation during the interviews, too.

Looking at the patterns of all six Q-factors illustrated in Table 5, it is noticeable that Q-factor A of the complete sample and Q-factor C of the acceptance subsample show an almost identical pattern, which is likely in sub-sampling. If we analyze the 89 Q-sorts that significantly correlate with Q-factor A of the complete sample, we see that 98% of them belong to participants that accepted “their” instrument. In contrast, 47% of the Q-sorts that significantly correlate with Q-factor B of the complete sample

Table 5. Rankings of the six Q-factors by $ZSC_{-1:1}$-score; sorted in descending order according to the $ZSC_{-1:1}$-scores of Q-factor C.

Statement ID	Title	Statement	$ZSC_{-1:1}$ values by statement and Q-factor (QF)					
			Complete sample		Acceptance subsample	Rejection subsample		
			QF A	QF B	QF C	QF D	QF E	QF F
19	***Effect on myself***	*Effect on myself: the ⇉ instrument ⇇ is not affecting me myself as I am not owning land*	*0.533*	*0.552*	*0.544*	*0.528*	*0.438*	*0.420*
20	**Number of regulations**	Number of regulations: introducing the "⇉ instrument ⇇" increases the quantity of regulations	0.418	−0.043	0.408	−0.115	0.019	−0.580
16	***Existing regulations***	*Existing regulations: the ⇉ instrument ⇇ is compatible with existing regulations*	*0.283*	*0.130*	*0.276*	*0.159*	*0.295*	*0.302*
6	**Fairness of the instrument**	Fairness of the instrument: it is fair that landowners have to pay for the costs of the ⇉ instrument ⇇	0.256	0.114	0.268	0.201	0.249	−0.217
13	**Power of municipality**	Power of municipality: the instrument empowers the municipality to decide on how to use and manage the soil	0.250	0.052	0.234	−0.009	0.504	0.048
5	**Costs of implementation**	Costs of implementation: the costs for implementing the "⇉ instrument ⇇" are appropriate	0.219	0.203	0.228	0.245	−0.109	−0.443
21	**Representation**	Representation: the way of representing the ⇉ instrument ⇇ was understandable	0.112	0.428	0.180	0.487	−0.137	0.286
22	**Functionality**	Functionality: the functionality of the "⇉ instrument ⇇" was clear	0.103	0.418	0.155	0.409	−0.167	0.369
10	**Difference of sealed surface**	Difference of sealed surface: the difference of sealed surface with and without the ⇉ instrument ⇇ is appropriate	0.163	−0.400	0.096	−0.375	−0.305	0.000
17	**Credibility of development**	Credibility of development: the shown developments are likely to happen given	0.089	−0.034	0.081	−0.076	0.042	0.128

(*Continued*)

Table 5. (*Continued*).

Statement ID	Title	Statement	ZSC$_{-1:1}$ values by statement and Q-factor (QF): Complete sample QF A	Complete sample QF B	Acceptance subsample QF C	Rejection subsample QF D	Rejection subsample QF E	Rejection subsample QF F
		the implementation of the ⇉ instrument ⇇						
18	**Personal political attitude**	Personal political attitude: the ⇉ instrument ⇇ matches my personal political attitude	−0.024	0.442	0.080	0.412	0.158	−0.092
23	**Mode of operation**	**Mode of operation: the mode of operation of the "⇉ instrument ⇇" was clear**	**0.025**	**0.276**	**0.058**	**0.455**	**−0.496**	**0.072**
11	**Difference of consumed soil quality**	Difference of consumed soil quality: the difference of consumed soil quality with and without the ⇉ instrument ⇇ is appropriate	0.086	−0.349	0.051	−0.336	−0.213	−0.010
14	**Quantity of sealed surface**	**Quantity of sealed surface: implementing the ⇉ instrument ⇇, the quantity of sealed surface is appropriate**	**0.090**	**−0.315**	**0.025**	**−0.432**	**0.112**	**0.365**
4	**Allocation of funds**	Allocation of funds: the generated funds are usefully applied	−0.113	0.166	−0.062	0.049	0.044	0.019
8	***Relative advantage of the instrument***	*Relative advantage of the instrument: introducing the "⇉ instrument ⇇" provides an advantage toward existing spatial planning instruments*	*−0.125*	*−0.059*	*−0.111*	*0.011*	*−0.079*	*−0.163*
12	**Effectiveness of the instrument**	Effectiveness of the instrument: the ⇉ instrument ⇇ helps to ensure good quality settlement growth	−0.091	−0.330	−0.133	−0.311	−0.478	−0.027
2	***Configuration***	*Configuration: The ⇉ instrument ⇇ is ⇉ type ⇇ which is the right strategy for spatial planning*	*−0.139*	*−0.219*	*−0.174*	*−0.297*	*0.033*	*0.045*
15			−0.432	−0.137	−0.429	−0.154	0.129	0.217

(*Continued*)

Table 5. (*Continued*).

Statement ID and title		Statement	ZSC$_{-1:1}$ values by statement and Q-factor (QF): Complete sample QF A	Complete sample QF B	Acceptance subsample QF C	Rejection subsample QF D	Rejection subsample QF E	Rejection subsample QF F
	Consumption of good quality soil	Consumption of good quality soil: the consumption of good quality soil is reduced applying the ⇉ instrument ⇇						
9	***Effect***	*Effect: the intended effect of the instrument (reduction of urban sprawl and protection of good soil) is achieved*	*−0.399*	*−0.448*	*−0.429*	*−0.472*	*−0.265*	*−0.011*
1	**Type of intervention**	Type of intervention: ⇉ type ⇇ is a useful measure to ensure the protection of good quality soil	−0.396	−0.241	−0.442	−0.152	0.201	−0.021
3	**Basis for assessment**	Basis for assessment: soil quality as basis for the assessment where to build is useful	−0.467	−0.010	−0.447	−0.026	0.058	−0.284
7	***Necessity of the instrument***	*Necessity of the instrument: The ⇉ instrument ⇇ is necessary to shape our space and strengthen settlement development within current urbanized area as well as the protection of good quality soil*	*−0.441*	*−0.194*	*−0.456*	*−0.200*	*−0.034*	*−0.422*
		Variance explained (%)	**20.73**	**11.04**	**28.81**	**17.72**	**12.71**	**12.60**
		Number of sig. Loads (Nload)	**89**	**36**	**95**	**15**	**9**	**10**

Colors of the statements indicate the assignment to the corresponding acceptance factor. Colors of the Z-scores indicate the importance of the respective statement within each of the six Q-factors (red = "not important," green = "very important"). Bold statements and numbers highlight distinguishing statements. Italic statements and numbers highlight statements of consensus. A distinguishing statement is one whose rank is statistically rather different across the six Q-factors ($p < .05$). A statement of consensus is a statement whose rank is statistically rather similar across the six Q-factors. The figure was developed following Nost, Robertson, and Lave (2019). The ⇉ instrument ⇇ placeholder was replaced by the name of the respective instrument, each participant drew randomly ("fee on soil quality" (1), "quota of soil quality" (2), "restriction of high soil quality areas" (3)); the ⇉ type ⇇ placeholder was replaced by a short description of the type of intervention of each instrument ("using market-based mechanisms like monetary incentives" (1), "using the determination of quotas at the municipal level to link the consumption of soil to its quality" (2), "restricting to build on good quality soil" (3)).

belong to participants who accepted “their” instrument and 53% to those who rejected it.

The most important argument for the acceptance of an instrument (Q-factor C) is a justifiable or no *effect on oneself* (19; $ZSC_{-1:1} = 0.42$). Another important argument is whether an instrument is perceived as a good complement to *existing regulations* (16; $ZSC_{-1:1} = 0.28$) and does not unnecessarily increase the *number of regulations* (20; $ZSC_{-1:1} = 0.41$). A further important argument for the acceptance of an instrument is, that it *empowers the municipality* (13; $ZSC_{-1:1} = 0.23$) to manage soil with the instrument. The *fairness of the instrument* (06; $ZSC_{-1:1} = 0.27$) and balanced cost-benefits (05; $ZSC_{-1:1} = 0.23$) are important for acceptance, too. Rather unimportant for the acceptance are the *necessity of the instrument* (07; $ZSC_{-1:1} = -0.46$), its *basis for assessment* (03; $ZSC_{-1:1} = -0.45$), and the *type of intervention* (01; $ZSC_{-1:1} = -0.44$). The statements *effect* (09; $ZSC_{-1:1} = -0.43$) and *consumption* of *good quality soil* (15; $ZSC_{-1:1} = -0.43$) are unimportant for the acceptance of an instrument, even if significant effects are actually visible on the basis of the modeling.

Three quite different patterns of argumentation are the result of our analysis of the rejection subsample. In Q-factor D, statements of the acceptance factor *understanding of the instrument* (21; $ZSC_{-1:1} = 0.49$ | 23; $ZSC_{-1:1} = 0.46$ | 22; $ZSC_{-1:1} = 0.41$) play an important role for arguing the rejection. The acceptance factor *effect on people* (19; $v = 0.53$ | 18; $ZSC_{-1:1} = 0.41$ | 06; $ZSC_{-1:1} = 0.20$) also plays an important role in the rejection of an instrument. In contrast, almost all seven statements of the acceptance factor *effect of the instrument* have no importance for the rejection. A similar pattern can be found for Q-factor E. The statements *effectiveness of the instrument* (12; $ZSC_{-1:1} = -0.48$) and its *effect* (09; $ZSC_{-1:1} = -0.27$) are unimportant for Q-factor E’s rejection. Contrary to Q-factor D, a negative *effect on oneself* (19; $ZSC_{-1:1} = 0.44$) as well as the opinion that the instrument *empowers the municipality* too much (13; $ZSC_{-1:1} = 0.50$) are the most important statements. Accordingly, the instrument is perceived as *unfair* (06; $ZSC_{-1:1} = 0.25$) and might not be implemented within the *existing regulations* (16; $ZSC_{-1:1} = 0.30$). For Q-factor E, the acceptance factors of *effect on people* and *institutional embeddedness* are the most important for the decision. For Q-factor F, the main arguments for rejection are lacking understanding of the *functionality* (22; $ZSC_{-1:1} = 0.37$) of the instrument as well as its *representation* (21; $ZSC_{-1:1} = 0.29$), *mode of operation* (23; $ZSC_{-1:1} = 0.07$), and, thus, its *credibility* (17; $ZSC_{-1:1} = 0.18$). The integrability of the instrument into the *existing regulations* (16; $ZSC_{-1:1} = 0.30$) was found to be a further important argument as well as inappropriate effects of the instrument on *quantity of sealed surface* (14; $ZSC_{-1:1} = 0.37$) and *consumption of good soil quality* (15; $ZSC_{-1:1} = 0.22$). Based on this lack of understanding and the effects of the instrument perceived as too low, the *effect on oneself* (19; $ZSC_{-1:1} = 0.42$) was perceived as negative and thus was a strong argument for the rejection.

To investigate the saliency of the six Q-factors, we analyzed the range (min-max) of the Z-scores as well as their distinctive zeros, as shown in Figure 3. For example, Q-factor A and Q-factor B of the complete sample show quite a similar range. However, in Q-factor A, two statements (19 and 20) are important, while in Q-factor B there are four statements (18, 19, 21, and 22) which are of similar importance for this social perspective. The five least important statements (09, 10, 11, 12, and 14) of Q-factor A also have a high saliency. Another noticeable finding of this analysis is, that Q-factor E of the rejection subsample has the highest range of ZSC, indicating a high saliency of the lateral statements.

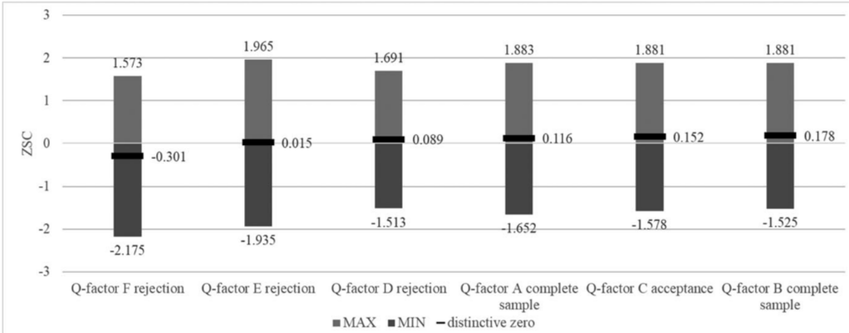

Figure 3. Range of ZSC (min to max) and distinctive zeros by Q-factor in ascending order.

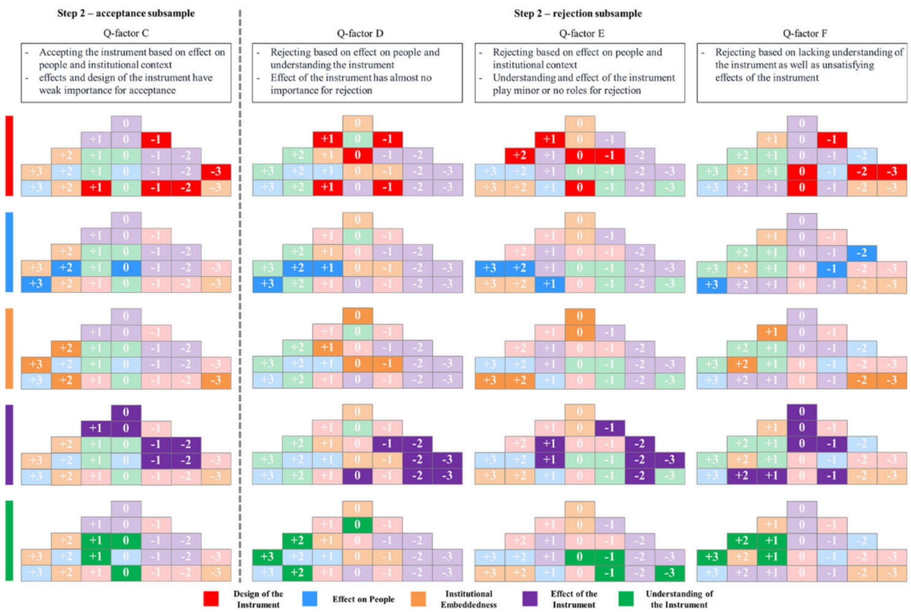

Figure 4. Step 2—acceptance and rejection subsamples—patterns of argumentation (Q-sorts) of the four Q-factors.

Analyzing the patterns of argumentation of Q-factors C, D, E, and F for each of the five acceptance factors, distinct social perspectives can be identified. Figure 4 briefly highlights the characteristics of each of the perspectives and illustrates the statements' patterns for each of the five acceptance factors. Overall, it can be found, that *effect on people* is the most important acceptance factor, as it was used strongly in all of the four social perspectives for arguing acceptance and rejection, except for Q-factor F of the rejection subsample, where the *effect on myself* (19) is the only statement of this acceptance factor that is used strongly for argumentation. The acceptance factor *design of the instrument* plays a rather unimportant role for acceptance, but Q-factor E of the rejection subsample indicates that a disagreement with the statement *type of the instrument* (01) might support a rejection, which was subject to further investigations during the interviews. The respective statements of the acceptance factors *institutional embeddedness* and *understanding of the instrument* are the most widely spread statements across the four Q-factors C, D, E, and F, which outlines their supportive role for both, an accepting or a rejecting attitude toward the object of acceptance. Despite the fact, that the framing goal of the three instruments is to manage the sustainable use of soil, the acceptance factor *effect of the instrument* plays a rather unimportant role. During the interviews, this was subject to further investigations.

Participants in the interviews had to repeat the same Q-sorting exercise they conducted during the online survey. We analyzed the differences in importance of the 23 statements for the argumentation of the interviewees compared to their Q-sorts from the online survey.

Figure 5 illustrates the differences in importance based on the average Z-score value of each statement across the 17 interviewees during the online survey and the interviews. Statements that are located top-left were rather unimportant for the argumentation during the online survey but of rather high importance during the interviews. Statements of the acceptance factors *design of the instrument* and *effect of the instrument* can be mainly found in this category. Furthermore, the statement *necessity of the instrument* gained importance during the interviews while being less important for acceptance during the online survey. In contrast, statements of the acceptance factors *understanding of the instrument* and *effect on people* lose importance for the argumentation during the interviews, but are of relatively high importance during the online survey. It is obvious, that rather person-related statements (e.g. 19, 18, 06, 21, 22, 23) are of low importance during the interviews, while idealistic and fact-based statements (e.g. 01, 02, 03, 07, 09, 12) are of high importance during the interviews. To investigate the validity of this result, we conducted a multi-factor analysis of variance (ANOVA) (detailed results can be found in Appendix D.1 [online supplementary material]). Summarized, it can be said that participants in the online survey use soil quality as the basis for assessment (*basis for assessment*; 03) differently depending on whether they accept or reject an instrument. Accordingly, the respective opinion on whether soil quality should be used as a basis for spatial planning decisions plays an ambivalent role, depending on whether one accepts or rejects the respective instrument. The same statement was also used significantly differently by the two interviewees who changed their opinion on the instrument in the interviews compared to the online survey. When opinion was changed from rejection to acceptance of the spatial planning instrument, the statement *basis for assessment* (03) was more important in justifying this change of opinion toward acceptance of the spatial planning instrument than when opinion was changed from acceptance to rejection. The same effect and effect direction was also found for the statements *allocation of funds* (04) and for *consumption of good quality soil* (15), where the effect direction was inverted. *The statement consumption of good quality soil* was more important for changing an opinion from acceptance to rejection.

Participants argue significantly differently with the statement *fairness of the instrument* (06), depending on which instrument was randomly assigned to them. This effect was found to be strong ($f = 0.967$) when comparing the patterns of argumentation of participants who drew instrument 1 (fee on soil quality) and instrument 2 (quota of

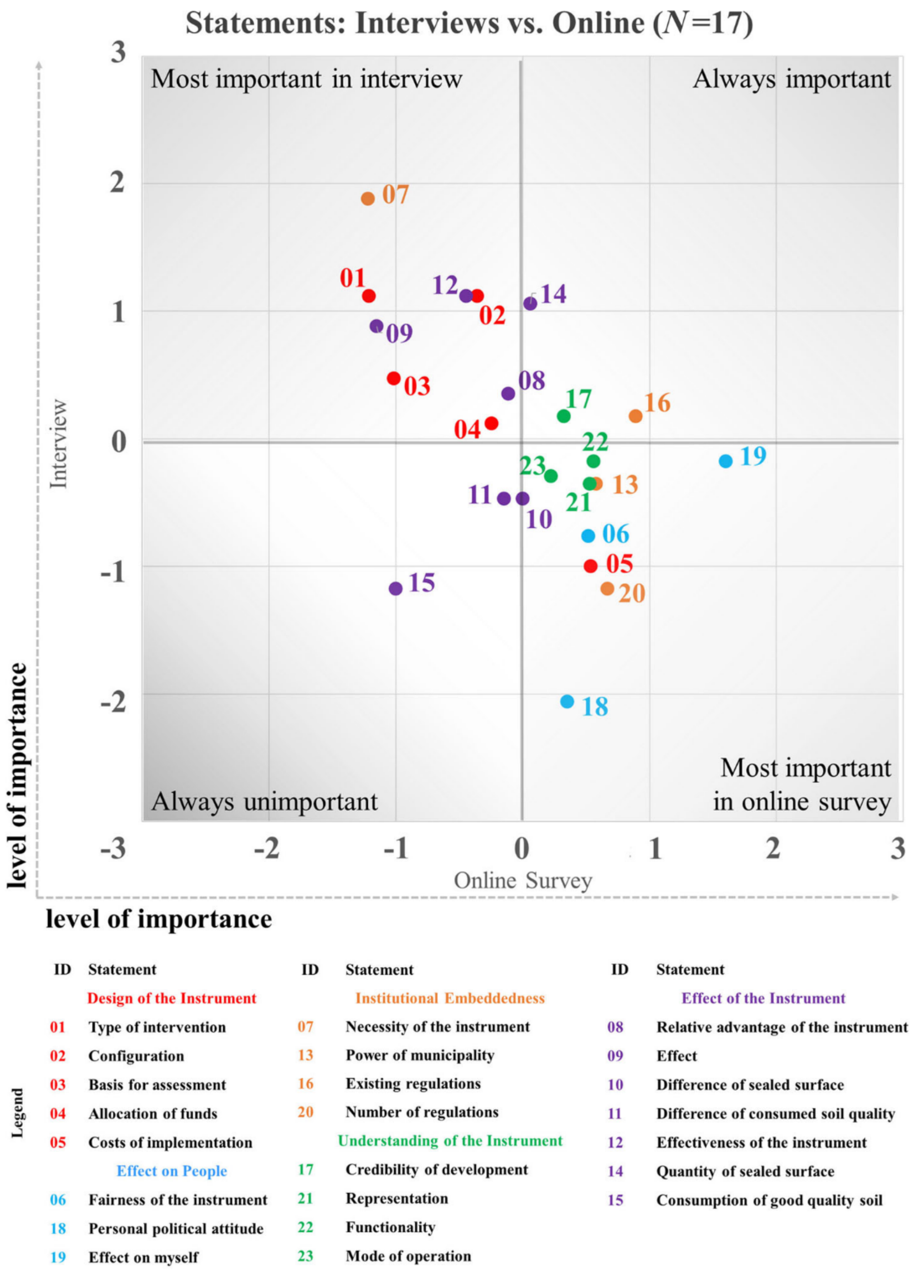

Figure 5. Level of importance of the 23 statements during the online survey and interviews.

soil quality). Participants who drew instrument 2 used the statement *fairness of the instrument* with more importance to argue their opinion in the online survey, while participants who drew instrument 1 used this statement with more importance to argue their opinion in the interviews.

4. Discussion

Sustainable management of the resource soil requires spatial planning strategies that are acceptable to the public. To support the design of such strategies, we show how Q-methodology can be used to examine the factors that influence the acceptance of spatial planning instruments that manage soil quality. Our suggestion to combine acceptance factors known from the literature into five formulated acceptance factors in our research context (cf. section 2.1 Factors of acceptance) adds a valuable layer of information for interpreting our results. We also show that the role of these five acceptance factors differs depending on whether the related statements were sorted by participants during the online survey or during the interviews.

Although it contrasts with the self-reporting of participants in the online survey (Figure C.2 [online supplementary material]), an insufficient *understanding of the instrument* seems to negatively influence the acceptance of an instrument under certain circumstances. In such a case, statements of the acceptance factor *understanding of the instrument* are often mentioned in combination with statements of the acceptance factors' *effect on people* or *institutional embeddedness,* and *effect of the instrument* to justify rejection (cf. Table 5). Wolsink (2000, 57) find that an initially positive attitude toward the object of acceptance (e.g. the proposed policy instrument) can change to negative, if concerns or changing risk perceptions cannot be mitigated through information or discussion. Furthermore, mistrust and concerns over particular aspects of the object of acceptance are reducing the openness to new information (Huijts, Molin, and Steg 2012, 2781). Upham and Pérez (2015, 592) find the same in their research and add that perceived unfairness can reinforce mistrust toward the government.

To accept an instrument, it has to be perceived as fair and reasonable in terms of cost-benefit. The most salient statement for participants of our online survey to argue their rejection was the *effect on oneself* (19). It is therefore evident that the perceived effects on oneself must be rated as appropriate or proportionate by a person for an instrument to be accepted. These findings are also in line with previous research (cf. Pleger 2017; Soss and Schram 2007; Upham and Pérez 2015, 595; Gärling and Loukopoulos 2007, 320; Batel, Devine-Wright, and Tangeland 2013, 1). The perceived importance of the goal of an instrument is more important than its actual effects. But it has to be understandable, how the new instrument fits into existing political procedures and that the instrument cannot be misused by authorities.

Of course, instruments also differ in their operational mechanisms, which could lead to different types of instruments being accepted in varying ways. It is known from the literature that stricter policy instruments tend to be less accepted (cf. Pleger 2017). We also found a hint of this in our analysis. The ANOVA showed that participants with the statement *fairness of the instrument* (06) argued in opposite ways in comparison between the online survey and the interviews, depending on whether they drew instrument 1 (fee) or 2 (quota). Based on this, it is reasonable to examine the full dataset with a focus on the three different instruments to understand whether and how, if at all, the role of the five acceptance factors differs for the acceptance of the three instrument types. In this paper, due to the size and complexity of our survey, we decided to explore our data on a coarser scale first.

Individual affectedness (19) was an important argument in the online survey in particular, both for acceptance and rejection. In contrast to the face-to-face interview situation, this argument seems to be more important in the anonymity of the masses and thus at the level of the online survey. Other studies also find, that the degree of affectedness has an influence on acceptance (cf. Petrova 2016; Huijts, Molin, and Steg 2012; Pleger 2017). If people hold doubt over the fair allocation of risks and benefits of a new instrument or perceive its effects as too negative, the acceptance factor *effect on people* can overrule other acceptance factors. Often, the communication of policy-makers is unidirectional and it is difficult to find a good balance between complexity and comprehensibility for them to communicate with the public (cf. Wicki, Huber, and Bernauer 2020). During the interviews, statements of the acceptance factor *understanding of the instrument* were slightly less important overall. Interviewees stated that the option to ask questions during the interviews was appreciated more than the unidirectional information they received during the online survey. Thus, on the face-to-face level, idealistic and fact-based arguments are of more importance for acceptance, while person-related arguments lose importance. This finding is in line with the research by Huijts, Midden, and Meijnders (2007, 2781), according to which understanding of details is secondary, if institutional trust exists. Informing the public is a complex and resource-consuming task, which makes it a challenge for policy-makers to find a good balance in complexity and amount of communication to the public.

One difficulty in research on acceptance is the generalizability of findings (cf. Batel, Devine-Wright, and Tangeland 2013; Müller and Kals 2004). Here, one strength of our approach is, that Q-methodology reveals social perspectives, that are substantive inferences (cf. Thomas and Baas 1992). Thus, Q-factors are, in some sense, a generalization of how individuals think about the object of acceptance (e.g. a policy instrument). The characteristic Q-sorts that emerge for each Q-factor are based on the responses of multiple participants and, in this sense, are generalizations of their perspectives (cf. Brown 1980; Thomas and Baas 1992). We identified six different social perspectives, but without being able to draw conclusions about the proportional distribution of these perspectives among the general public (cf. Zabala 2015). Further research could use these social perspectives to identify their shares in a population and eventually find additional perspectives. One advantage of this would be to know the proportions of different social perspectives in the population and thus be able to address the different perspectives individually. In this way, it could also be investigated what changes such an individualized communication strategy would bring. Another benefit might be to adjust the communication about a process of policy-making based on the knowledge about the six social perspectives identified. For example, possible effects of a proposed policy instrument could be specifically explained and examples in a specific regional or individual context could be included. During the interviews, we received the feedback, that the maps we used in our study (cf. Figure B.2 [online supplementary material]), showing the possible effects of the instrument in the respective municipality of the participants, were very much appreciated. Participants would welcome a local context of information, even if the overall context of the instrument would be national or cantonal, because it helps them to understand the risks and benefits better and how the instrument would affect themselves. Wüstenhagen, Wolsink, and Bürer (2007, 2689) are also pointing to this aspect in their research, summarizing, that it is a key challenge for socio-political acceptance to bridge the national-local divide.

In contrast to other studies using Q-methodology, our complete sample is larger than average and only few studies with more than 100 participants exist (Zabala, Sandbrook, and Mukherjee 2018, 1190; Sneegas *et al.* 2021, 6ff). The focus of a Q-study should always be on the primary research interest and the selection and composition of the complete sample should be appropriately purposive (cf. Brown 1980; Zabala, Sandbrook, and Mukherjee 2018). In compiling our comparatively small Q-set (23 statements), we were particularly concerned with increasing the willingness to participate through a relatively short online survey (cf. Ward *et al.* 2017). Our target audience for the online survey were the inhabitants of the case study communities, and we therefore had to assume that the general interest in participating in a survey about spatial planning and soil management would be rather low. Moreover, due to the size of our case study area and the parallel questioning across the three different instruments during the online survey, we ended up with a comparatively high number of 277 study participants (cf. Sneegas *et al.* 2021). As such, our research extends the usual design of Q-studies as done by others (cf. Wolsink and Breukers 2010; Curry, Barry, and McClenaghan 2013, 645; Sneegas *et al.* 2021). The higher effort in evaluating and analyzing the study results is balanced by the advantage that we were able to generate different subsamples due to the larger complete sample. Being able to compare the different samples helped us to get a better feeling for the interpretation of our results, which enabled us to deal with our own researcher's subjectivity more responsibly (cf. Sneegas 2020). Thus, we could also say that we pooled, evaluated, and compared several smaller Q-studies, each of which had average participant numbers (cf. Sneegas *et al.* 2021). In addition, the online implementation of Q-sorting makes Q-methodology useful for acceptance research, and allows for easy administration of a survey to more participants or for application to other contexts.

Another difference of our study compared to other Q-studies is, that we did not specifically choose the participants in the study. Methodologically, it would be equally possible to conduct the online survey and the interviews in terms of a classical Q-study. From the theory (cf. Webler, Danielson, and Tuler 2009; Zabala, Sandbrook, and Mukherjee 2018), it is recommended to include at least one representative of the involved actors in a field of interest, based on their contextual knowledge or opinions and/or their interest in a topic. In our research design, however, we wanted to investigate the importance of the five acceptance factors depending on whether they are voted on anonymously (online survey) or in person (interviews). For the online survey, participants were not chosen particularly. One could argue that participants *chose themselves* by participating in the online survey (limitation), only attracted by the topic itself and a chance to win a monetary prize, as indicated in the invitation letters. The socio-demographic characteristics of our complete sample (Table B.3 [online supplementary material]) are quite heterogeneous and comparable to the Swiss average, which rather supports our sample to be unbiased. Yet, there is a slightly higher share of males (67.5%) compared to females (28.5%), which we cannot conclusively explain. Based on this consideration, our results suggest that there may be differences in the importance of the acceptance factors depending on whether they are voted on anonymously (online survey) or in person (interviews). This implies that a combined research design such as ours may open up new possibilities for gaining a deeper understanding of the importance of the various acceptance factors in other research contexts.

Given the high number of invitation letters distributed (approx. 15,000), the weak response rate (2%–6%; Table 3) might be criticized. On the one hand, the framing topic of spatial planning and managing the resource soil is of rather low interest amongst the Swiss population in relation to a time investment of circa 15 min to complete the survey. On the other hand, the letters of invitation are in direct competition to inflationary distributed leaflets and advertisement letters, which Swiss households receive daily. Through both the monetary incentive and the sheer volume of invitation letters distributed and their professional design, we have attempted to address these challenges. To make participation in a possible future study even more attractive in such a context, additional effort would have to be taken into account.

Overall, our findings suggest the need for diversification in policy information and communication strategies that serve to inform the people. The different meanings of the five acceptance factors within the identified social perspectives should also be considered in the information and communication strategies of policy-makers in order to better address these social perspectives, accordingly. Room for building trust, opportunities to answer questions with low effort for the people, and translating possible effects of an instrument to a local context are further recommendations we can summarize based on our findings. Future research could adapt our approach and also transfer it to other contexts to evaluate similarities and differences in acceptance of policy instruments.

5. Conclusion

The *effect on people* as well as *institutional embeddedness* and *understanding of the instrument* are overall the most important acceptance factors influencing the acceptance of spatial planning instruments that manage soil quality. Because the emergence of acceptance is a complex process and there is no universal way to influence it, our findings offer potential benefits through in-depth knowledge for policy-makers in particular (cf. Schenk, Hunziker, and Kienast 2007). In order for the people to better understand the effects of a new instrument, the effects of proposed spatial planning instruments should be illustrated and explained at the local level. In addition, public communication should address certain aspects separately, such as how an instrument fits into existing regulations or how regulatory abuse of the instrument is avoided. Future research should transfer the acceptance factors we used to different contexts and test their applicability. On the methodological side, we can conclude that Q-methodology was useful in uncovering social perspectives that exist among the inhabitants of our case study area and in characterizing these perspectives. The strength of the methodology lies in statistically identifying typical patterns across individuals that are interpretable, thus allowing us to identify consensus and opposition across social perspectives.

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Supplemental data

Supplemental data for this article can be accessed here.

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ORCID

Manuel Sudau http://orcid.org/0000-0003-3230-9160
Enrico Celio http://orcid.org/0000-0003-1316-1850
Adrienne Grêt-Regamey http://orcid.org/0000-0001-8156-9503

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