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Understanding Birdwatching Motivation Through the Lens of Self-Determination Theory

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ABSTRACT

Motivational variables are becoming one important focus of research into birdwatching. However, previous research mostly lacks examining externally determined motivation, although this research suggests that such qualities of motivation exist. To address this research gap, we first developed an instrument to investigate different self-determined and externally determined motivational regulations regarding birdwatching. To explore these regulations further, we investigated how different degrees of perceived autonomy predict these regulations and how they are related to different birding behaviors. The questionnaire data of 562 birdwatchers (M_{age}=49.17 ± 17.07 years) were included. We found four factors to assess birdwatchers' motivational regulation: intrinsic, identified, introjected, and external. Autonomy need frustration strongly predicted externally determined regulations, while self-determined regulations were more likely to be predicted by autonomy need satisfaction. The types of motivational regulation were also accompanied by different behaviors. Our research widens the perspective on and enables the assessment of motivational regulation regarding birdwatching.

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birding; birdwatching; citizen science; motivation; test instrument

Introduction

Research in the field of motivation regarding birdwatching has primarily focused on two important questions: What motivates individuals to birdwatch (Glowinski & Moore, 2014; McFarlane, 1994; Randler & Großmann, 2022a), and how can people be motivated to carry out such nature-related leisure activities or similar ones that are related to conservation (DeCaro & Stokes, 2008; Larson et al., 2020)? Previous research has mostly addressed self-determined qualities of motivation and related variables in the context of birdwatching and leisure activities more broadly (Chen & Pang, 2012; Großmann & Randler, 2025; Walker et al., 2020). This emphasis may stem from the assumption that self-chosen leisure activities are intrinsically rewarding and voluntarily chosen (Iso-Ahola & Baumeister, 2023). However, the results of a recent study suggest that conditions may exist that counteract self-determined motivation and contribute to externally determined motivation during birdwatching; for instance, one's

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psychological needs can be frustrated, which hinders intrinsic motivation and promotes extrinsic motivation (Großmann & Randler, 2025).

Given the paucity of knowledge regarding extrinsic motivation in birdwatching, a *first research desideratum* is to ascertain the types of externally determined motivational regulation that coexist with self-determined motivational regulation and the extent to which they are present in this leisure activity. Self-determination theory allows for a nuanced understanding of motivation, as it encompasses a range of motivational regulations that have been widely researched and empirically tested (Ryan & Deci, 2017). However, to investigate these regulations, it is necessary to develop a test instrument that is suitable for the context of birdwatching.

To gain a deeper understanding of these different motivational regulations and identify potential avenues for motivating individuals to engage in birdwatching, it is essential to investigate the antecedents (*research desideratum 2*) and outcomes (*research desideratum 3*) of different motivational regulations in a subsequent phase of inquiry. The current study addresses these research desiderata.

Theory

Motivation in self-determination theory

Organismic integration theory, a sub-theory of self-determination theory (Ryan & Deci, 2017), describes two types of qualities of motivation (intrinsic and extrinsic) that an individual can experience while engaging in an activity, which can differ in terms of the underlying regulatory processes. For intrinsic motivation, only one motivational regulation is described, namely intrinsic regulation. When an action is intrinsically motivated, an individual pursues the goal of acting and no other goal related to the action (Ryan & Deci, 2017). The action is performed to feel an inherent sense of satisfaction and pleasure and is perceived as self-determined (Ryan & Deci, 2017). Extrinsically motivated actions are performed to achieve a goal that is related to the action but is not the action itself (Ryan & Deci, 2017; Vallerand & Ratelle, 2002). Therefore, these actions are described as instrumental (Vallerand & Ratelle, 2002); however, they are not exclusively perceived as externally determined (Reeve, 2018; Ryan & Deci, 2017).

Ryan and Deci (2017) describe four types of regulation that can underlie extrinsically motivated actions and are defined in Table 1. These types of regulation differ in their degree of perceived self-determination (Ryan & Deci, 2017).

The type of motivational regulation that underlies an action and, consequently, the quality of motivation an individual perceives in an action is determined by the extent to which the basic psychological needs for relatedness, competence, and autonomy are satisfied (Ryan & Deci, 2017; for leisure activities see Gui et al., 2019; Walker & Kono, 2018; Walker et al., 2020). To assess this, a distinction is made between the satisfaction and frustration of these needs, which are often measured separately in empirical studies (Chen et al., 2015; Heissel et al., 2018). Since the differences in motivational regulation are primarily attributed to differences in perceived self-determination, the current study focuses on the corresponding basic need for autonomy (see Ryan & Deci, 2017). This need describes individuals' endeavors to be the masters of their actions as well as to

Table 1. Definitions of the four different types of regulation of extrinsic motivation.

Motivational regulation	Definition
External regulation	• individuals strive to achieve a positively-valued state (e.g. a reward) or to avoid a negatively-valued state (e.g. poor performance) (Ryan & Deci, 2017; Vallerand & Ratelle, 2002) • actions are not carried out unless a positive or negative external incentive is present (Ryan & Deci, 2017; Thomas & Müller, 2016) • perceived as externally determined (Vallerand & Ratelle, 2002)
Introjected regulation	• actions are performed to avoid feelings of anxiety, shame, and guilt (Vallerand & Ratelle, 2002) • individuals adopt the rules, norms, and values of others in their environment to think, feel, or act (Reeve, 2002) • feelings of recognition and pride arise (Assor et al., 2009; Ryan & Deci, 2017) • perceived as being externally determined and involve some kind of inner obligation (Vallerand & Ratelle, 2002)
Identified regulation	• actions are carried out because the individual perceives the goal and the underlying values of the action as being personally meaningful and valuable (Ryan & Deci, 2017) • underlying goals of the action can still be separated from the individual's beliefs and thus be incoherent with his/her personality structures (Vallerand & Ratelle, 2002) • accompanied by perceived self-determination (Ryan & Deci, 2017)
Integrated regulation	• coherence between the goals of the action and the goals of the self is given (Ryan & Deci, 2017; Vallerand & Ratelle, 2002) • similarities with intrinsically regulated actions such as perceived self-determination and voluntary action (Ryan & Deci, 2002) • actions are still carried out to achieve a goal that is separate from the action itself (Ryan & Deci, 2002)

act voluntarily and without pressure (Reeve, 2018; Ryan & Deci, 2017). Having a sense of choice in action is a further quality of perceiving autonomy (Reeve, 2018; Ryan & Deci, 2017). The satisfaction and frustration of this basic need, as well as resulting motivational regulations, can significantly influence individuals' behavior (Ryan & Deci, 2017). On the one hand, these variables may impact the persistence and the quality of the outcome of an action; on the other hand, they can determine which actions are carried out at all (Ryan & Deci, 2017).

Although considering the motives (e.g. Decker et al., 1987) and the role of human needs in well-being during leisure activities (e.g. Beard & Ragheb, 1983) is not a new idea, examining motivation, along with its antecedents and outcomes from the perspective of self-determination theory, is still in its early stages. Previous research on motivation and the relationship between motivation and behavior related to leisure in general, and birdwatching in particular, is discussed in the following sections. This broader view is necessary because research specifically on birdwatching does not yet exist for all constructs and relationships considered in the current study.

Birdwatching motivation

The study of motivation regarding (nature-based) leisure activities draws on different models. One line of research originates from Decker et al.'s (1987) model of wildlife-oriented motivation. To our knowledge, the most recent model that was tested supplements this model and describes six dimensions of motivation in birdwatching: social, achievement, appreciation, reputation, detachment, and conservation (Randler & Großmann, 2022a; see also Glowinski & Moore, 2014; Larson et al., 2020; McFarlane, 1994). In the context of avitourism, Maake et al. (2022) identified five motivational dimensions that partially overlap with the aforementioned dimensions: participation

in birdwatching, social interaction, relaxation and escape, lifestyle and well-being as well as photography and nature appreciation (see also Ren et al., 2022). Within this perspective of motivation, no distinction is made between self-determined and externally determined motives, which becomes particularly evident in how these motives are assessed empirically.

Another line of research focuses on intrinsic and extrinsic motivation as outlined in self-determination theory (Ryan & Deci, 2017). In the context of conservation, Tiago et al. (2017) investigated the intrinsic motivation—measured as interest/enjoyment—of participants in conservation activities. Frequent participation led to the highest interest/enjoyment in their study (Tiago et al., 2017). Richter et al. (2021) examined intrinsic and extrinsic motivation in citizen science insect monitoring and revealed differences regarding the investigated country and program. However, all investigated participants possessed a wide range of different intrinsic and extrinsic motives such as fulfilling personal desires or contributing to nature conservation (Richter et al., 2021). In a more recent study, Dowthwaite et al. (2025) focus on online citizen science and confirm a wide range of motives that are pursued in this activity. In their study, participation in online citizen science was mainly driven by interest and curiosity, enjoyment as well as helping conservation and science projects (Dowthwaite et al., 2025).

With a focus on leisure activities in general, Walker et al. (2020) investigated the relationship between leisure participants' basic need satisfaction and their intrinsic motivation. They found that autonomy need satisfaction was a significant predictor of intrinsic motivation in both samples investigated (British/Canadians, Hong Kong Chinese), while the prediction of competence and relatedness need satisfaction differed between these samples (Walker et al., 2020). Großmann and Randler (2025) carried out a similar analysis in the first validation of their test instrument for assessing basic need satisfaction and frustration during birdwatching and found effects of autonomy need satisfaction and frustration as well as relatedness need satisfaction on intrinsic motivation. However, these studies lack the consideration of extrinsic motivation. The scales used in a study by Larson et al. (2020) in the context of birdwatching address extrinsic motivation to some degree but do not differentiate between intrinsic and extrinsic motivation.

Research exploring intrinsic and different regulations of extrinsic motivation can be found in the field of leisure physical activity in particular (Kalajas-Tilga et al., 2020; Tilga et al., 2020; Tsorbatzoudis et al., 2006). For instance, Tilga et al. (2020) investigated the four types of motivational regulation (intrinsic, identified, introjected, and external) as autonomous and controlled motivation and tested them as mediators between autonomy-supportive and controlling teacher behavior in physical education and leisure physical activity.

In addition to examining motivational regulations and their antecedents, a further goal of our study is to investigate the outcomes of such self-determined and externally determined motivational regulations. Different birding behaviors are therefore discussed in relation to motivational regulation in the following sections.

Birding behavior

The leisure activity of birdwatching is not limited to the mere observation of birds. Different types of birding behaviors can be identified, each varying in terms of the

time and effort invested and the level of complexity (Randler, 2022; see Booth et al., 2011). First, birdwatching can involve group participation, such as going on a field trip. These field trips can not only be in the immediate vicinity, but also many kilometers/miles away from home (Booth et al., 2011), for instance, as part of avitourism (Conradie et al., 2013; Özkan, 2023). Much more demanding than mere participation in a local field trip is organizing and leading such a trip or excursion as well as giving presentations as part of birdwatching events (Lee & Scott, 2006; Randler, 2021). However, it is not only the transfer of knowledge that can be quite challenging. Ringing programs (e.g. Pavisse et al., 2019), the caretaking of nest boxes (e.g. Macak, 2020), as well as breeding and waterbird counts (e.g. Atkinson et al., 2006; Link & Sauer, 1998) can also be regarded as more complex activities (Randler, 2022). To involve more individuals in such activities, there are also simpler counts, such as the garden count of the Nature and Biodiversity Conservation Union Germany (NABU; see Randler, 2022). Here, every citizen is encouraged to count the birds in their yard/garden. On a much larger scale, birds are counted as part of bird races or birdathons (Connell, 2009; Kaufman, 2005), which are competitive events where participants aim to see the most birds (Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022b) and win the race or birdathon.

Differences in the time and effort invested in birding behaviors can be determined not only by the type of behavior, but also by the quantity of the behavior such as the number of field trips, the number of days spent birdwatching per year, or the number of reported observations on web-based platforms (see Lee & Scott, 2004; Randler & Großmann, 2022b). Of course, the type of activity that a birdwatcher engages in may also affect the quantity. For example, people who only participate in the NABU bird count are unlikely to undertake many field trips or spend many days birdwatching each year (see Randler, 2022). At the same time, people who participate in more demanding activities such as the breeding and waterbird counts may also have an interest in submitting observations on a regular basis. However, this also depends on the motives that are pursued with the activities. Therefore, the activities are considered from the perspective of motivational regulation in the following section.

Birdwatching motivation and birding behavior

Previous studies assume that the motives behind birdwatching can result in different behaviors (Aas et al., 2023; Randler & Großmann, 2022a). From the perspective of self-determination theory, the aforementioned birding behaviors can be assumed to reflect differences in underlying motivational regulation.

For example, participation in a field trip may be subject to intrinsic regulation, as birdwatchers may only pursue the goal of watching birds (see Ryan & Deci, 2017). In the case of bird counts and reported observations on web-based platforms (e.g. eBird; see Guilfoos et al., 2024), it could be assumed that the people engaging in these activities have recognized a personal significance and practical benefit such as contributing to conservation efforts (see Hermes et al., 2021). These activities may therefore be more likely to be based on identified regulation (Table 1). However, a distinction must be made between more and less complex counts and more or fewer reported observations. While, for instance, the less demanding and time-consuming NABU bird count or the few observations reported to platforms might be based on self-determined

motivational regulation, more complex counts and a large number of reported observations may also be accompanied by externally determined regulation. Birdwatchers may be concerned with recognition from or competition with others, for instance, by reporting more observations than other birdwatchers or by generating the longest possible list (see Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022a; Walker et al., 2020).

Analogous assumptions can be formulated for the more demanding activities such as ringing programs and nest box caretaking. Likewise, these activities can be either regulated in a self-determined manner (e.g. to contribute to nature conservation) or externally determined goals might be pursued (e.g. to gain recognition from other birdwatchers; Table 1). The transfer of knowledge that leading excursions and giving presentations entails could also be dedicated to the idea of nature conservation and personal meaningfulness and, therefore, be subject to self-determined motivational regulation (Table 1). At the same time, birdwatchers may seek recognition from their peers, which would support the pursuit of external goals (Table 1). The latter assumption is supported by the reduced self-determination that Lee and Scott (2006) found for birdwatchers with leadership roles that include such activities.

Because bird races and birdathons are competitive (Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022b), they might be subject to external regulation. Birdwatchers may have motivations such as winning the race or birdathon, counting as many birds as possible to supplement their lists, or performing better than their peers. At the same time, birdwatchers may seek to demonstrate their skills to themselves at these events or receive recognition from others. In such cases, their actions would be regulated in an introjected manner (Table 1). These assumptions are supported by a study by Randler and Großmann (2022b), who found that the social as well as the reputation dimensions of the supplemented Decker et al. (1987) model are of particular importance for birdathon participation.

Concerning the quantity of birding behaviors, it can be assumed that both self-determined and externally determined motivational regulations may result in a considerable number of reported observations and days spent birdwatching (see Ryan & Deci, 2017). It is plausible that birdwatchers may be motivated by external goals, such as attempting to create the longest possible list (see Walker et al., 2020), as well as being introjectedly regulated by the desire for recognition and the need to prove their skills to themselves (Table 1). Likewise, perceived personal meaningfulness and an associated identified regulation can result in a large number of reported observations and days spent birdwatching per year (Table 1). Since the goal of birdwatchers who express intrinsic regulation is the mere watching of birds, they might report a high number of days spent with birdwatching, although the number of observations may not necessarily be high (see Ryan & Deci, 2017).

Research desiderata

The review of the current state of research in this field reveals that intrinsic motivation has been the primary focus of research on leisure activities. While extrinsic motivation and underlying motivational regulations are occasionally addressed (Chen & Pang, 2012), they are only rarely analyzed empirically except in the context of leisure physical

activity (Tilga et al., 2020; Tsorbatzoudis et al., 2006). These previous studies, as well as previous findings regarding the frustration of basic psychological needs during birdwatching (Großmann & Randler, 2025), indicate that birdwatching may be subject to extrinsic motivation. This highlights the importance of investigating this type of motivation. Moreover, competitive events are a feature in both birdwatching and leisure physical activity (e.g. bird races/birdathons; Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022b). In such events, birdwatchers may participate due to external incentives.

Globally recognized and extensively studied at an empirical level, self-determination theory is particularly suitable for such studies because it differentiates extrinsic motivation in a more precise way than other motivation theories and recognizes that this type of motivation can be regulated in an externally determined and self-determined manner (Ryan & Deci, 2017). Thus, the perspective taken in self-determination theory provides a detailed view into extrinsic motivation. This insight is necessary because the presence of extrinsic alongside self-determined motivational qualities – even to a small extent – can affect well-being and recreation (see Ryan & Deci, 2017). To support optimal well-being and recreation among all birdwatchers, it is essential to identify the origins of extrinsic motivation. With this knowledge, birdwatchers can be sensitized to external incentives and measures can be developed to reduce externally determined motivation during birdwatching.

The current state of research further reveals that basic psychological needs are important antecedents of motivation in leisure activities, particularly the need for autonomy (Großmann & Randler, 2025; Tilga et al., 2020; Walker et al., 2020). In addition to considerations of extrinsic motivation and antecedents of motivational regulation, the present state of research lacks an investigation of the various birding behaviors as outcomes of different motivational regulations. Thus far, the motives underlying single specific behaviors such as conservation citizen science activities or tourism have been considered (e.g. Maund et al., 2020; Ren et al., 2022; Richter et al., 2021).

In our study, we addressed three research desiderata that have yet to be empirically answered. These are: (1) the investigation of motivational regulations regarding birdwatching as proposed by self-determination theory with a particular focus on externally determined regulation, (2) the examination of the antecedents of these motivational regulations, and (3) the testing of their relationships with different birding behaviors as outcomes of these motivational regulations. As extrinsic motivation in the sense of self-determination theory has not yet been studied in the context of birdwatching, a test instrument had to be developed first. The development of a test instrument for one specific leisure activity allowed us to consider that each leisure activity has unique characteristics that need to be addressed in the assessment of activity-related variables (see Großmann & Randler, 2025).

Materials and method

Sample

A total of 562 birdwatchers (M_{age} = 49.17 years, SD_{age} = 17.07 years, Mdn_{age} = 52.00 years, R_{age} = 12–88 years) from German-speaking countries (Germany 97%, Austria 0.5%,

Table 2. Means, standard deviations, median, and range of the participants' ratings of their skills.

Item	*M*	*SD*	*Md*	Range (*Min*–*Max*)
Please rate your ornithological skills.	3.33	0.99	3.00	1–5
How many birds can you identify by appearance (without aids)?	3.85	1.20	4.00	1–6
How many birds can you identify by song (without aids)?	3.98	1.30	4.00	1–6

Note. Rating scales: *Skills* 1 (novice) to 5 (expert); *Appearance* 1 (≤ 25 birds), 2 (26–45 birds), 3 (46–100 birds), 4 (101–250 birds), 5 (251–500 birds), 6 (> 500 birds); *Sound* 1 (≤ 5 birds), 2 (6–10 birds), 3 (11–25 birds), 4 (26–80 birds), 5 (81–150 birds), 6 (> 150 birds).

Switzerland 2.5%) participated in the online survey that assessed all investigated variables. Of the participants, 31.3% identified as female while 67.6% identified as male. Moreover, 0.7% of the respondents preferred not to rate this item, while 0.4% described themselves as "diverse." A majority of the sample (70%) held a university degree (bachelor's, master's, or diploma). To further characterize our sample, we asked the participants to rate their skills regarding birdwatching as well as how many bird species they could identify by their appearance and song without the help of any resources (see Randler et al., 2023). Table 2 illustrates that the participants exhibit variability in their self-assessment of their birdwatching skills and their skills to identify birds. On average, the participants rate their skills as moderate and can identify 101–250 birds by appearance as well as 26–80 per sound.

The recruitment of participants was conducted *via* the websites of German ornithological associations and mailing lists. The ornithological associations from all federal states in Germany as well as the website *Naturgucker* were contacted initially and, if necessary, subsequently reminded after one week. The call for the survey was disseminated by six associations as well as the website *Naturgucker via* their respective websites and mailing lists.

Despite differences in the size of the countries, there are many ornithologic associations in Austria, Switzerland, and Germany. However, more associations can be identified online for Switzerland and Germany than for Austria. No statements can be made about the geographical distribution for the small proportion of the sample from Switzerland and Austria. For the sample from Germany, these statements can be made based on the associations contacted. The websites that published the call addressed birdwatchers throughout Germany and thus all geographical areas. The six German associations that distributed the call to their members were located in different geographical areas (marine, rather rural, rather urban).

The survey was designed following German data protection guidelines. That is, the participants were informed about the handling and processing of their data, the anonymity of their data, and the voluntary nature of their participation. Afterward, they were asked to provide their informed consent. Each participant received a five-euro voucher and was given the opportunity to take part in a book raffle.

Test instruments

Motivational regulation

The test instrument designed to assess the motivational regulations proposed in self-determination theory (intrinsic, identified, introjected, external) was developed using the validated scales from Thomas et al. (2018) and the German scales from Randler

Table 3. Means, standard deviations, range, and factor loadings of the developed items as well as internal consistency of the scales of the 4-factor model.

	Intrinsic regulation	Identified regulation	Introjected regulation	External regulation	*M*	*SD*	Range (*Min–Max*)	Omega
I go birdwatching …								
1 due to esthetic aspects. Birds are simply beautiful to look at. *	.565				3.93	1.05	1–5	.65
2 because of my personal fascination with birds. *	.888				4.34	0.84	1–5	
3 because I really enjoy watching birds. †	.466				4.52	0.74	1–5	
4 because I personally find the activity very important. †		.719			3.50	1.14	1–5	.77
5 to contribute to the knowledge of birds in science and society. *		.609			3.36	1.29	1–5	
6 to collect data for nature conservation projects. *		.558			3.41	1.34	1–5	
7 to gain recognition from other birdwatchers. *			.701		1.76	0.96	1–5	.75
8 to show myself that I am a competent person. †			.606		1.98	1.12	1–5	
9 to prove to myself that I can be successful at birdwatching. †			.593		2.24	1.22	1–5	
10 to generate the longest possible list of bird species (e.g. local, regional, national, or global).				.677	2.28	1.31	1–5	.63
11 because I want to spot more birds than other birdwatchers.				.742	1.55	0.91	1–5	
12 because I would like to win competitions (e.g. a bird race or a bird quiz) with the knowledge I have acquired.				.486	1.29	0.68	1–5	

Note. * Items taken from Randler & Großmann (2022a), † Items based on Thomas et al. (2018). Rating scale ranging from 1 = "totally disagree" to 5 = "totally agree."

and Großmann (2022a; see Table 3). These scales are either based on a different theoretical framework, which nevertheless exhibits similarities with self-determination theory (Randler & Großmann, 2022a), or assess these regulations during university studies (Thomas et al., 2018). Therefore, not all of the items from the scales were suitable for measuring birdwatching motivation based on self-determination theory. Integrated regulation was not examined in this and previous test instruments due to a lack of knowledge regarding the participants' personal values, which are required to determine this type of regulation (see Thomas et al., 2018; Thomas & Müller, 2016).

The development process began with the selection of suitable test instruments. In this case, the objective was to identify validated German-language test instruments that examine motivation in the context of birdwatching, or that can be transferred to this context, and that would be suitable for the purposes of this study. A translation, which could have resulted in validity restrictions was not necessary. The adaption of these existing items as well as the formulation of new items were carried out by two

experts in the field of birdwatching motivation and self-determination theory. In this process, a regular exchange was held to determine which items could be adopted without modification, which items required only a change of context, and for which motivational regulation new items were required. As external incentives can vary depending on the activity and context, new items were especially needed for the subscale "external regulation" (Table 3).

Specifically, we reformulated one item from the introjected regulation subscale, but left the meaning unchanged, and newly formulated the three items on external regulation. With regard to the items from Thomas et al.'s (2018) scales, it was only necessary to modify the context (birdwatching; exchange of one word). The items from Randler and Großmann's (2022) scale could be used in their original formulation. The newly formulated items were presented to other members of the experts' departments, who were not necessarily working in the context of birdwatching or self-determination theory. This ensured that non-experts could also understand the items.

In the final step, a third expert in both research fields who had not been involved in the previous adaptation and formulation process was consulted to discuss the items and clarify open questions. For instance, it was verified whether all the essential facets of birdwatching motivation had been covered. A five-point rating scale ranging from 1 = "fully disagree" to 5 = "fully agree" was applied to assess the participants' agreement with the final 12 items.

Autonomy need satisfaction and frustration. The scales by Großmann and Randler (2025) were used to evaluate the satisfaction and frustration associated with the need for autonomy during birdwatching with three items each. The items were rated on the aforementioned five-point rating scale (example item *satisfaction*: "When birdwatching, I think I'm doing something that really interests me."; example item *frustration*: "When birdwatching, I sometimes feel pressured.). For both scales, an acceptable internal consistency was found (satisfaction: McDonald's ω = .61; frustration: ω = .73; Hayes & Coutts, 2020).

Birding behavior

A variety of birding behaviors, which differ in terms of time and effort required, were investigated through the lens of a single item. One item asked about the number of days that the participants spent birdwatching during the previous year with the following ranges: none, <10 (coded with 1), 11–30 (coded with 2), 31–70 (coded with 3), 71–200 (coded with 4), >200 (coded with 5). The number of reported observations per year to websites such as ornitho, eBird, or *Naturgucker* were assessed on the following scale: none (coded with 1), <10 (coded with 2), 11–50 (coded with 3), 51–100 (coded with 4), 101–200 (coded with 5), 201–500 (coded with 6), 501–1000 (coded with 7), 1001–2000 (coded with 8), >2000 (coded with 9). The same scale (never [coded with 1], one time [coded with 2], two to four times [coded with 3], five to ten items [coded with 4], > ten times [coded with 5]) was used to assess the following activities in which the participants took part: NABU bird count, breeding and waterbird count, ringing programs, nest box caretaking, bird race, field trip, and leading an excursion or giving a presentation.

Statistical analyses

In a first step, univariate outliers were identified based on the recommendation set forth by Leys et al. (2013), which involved applying the median values minus or plus 2.5 as a threshold and multivariate outliers based on the Mahalanobis distance analysis were omitted (chi-square at $p = .01$; e.g. Mitchell & Krzanowski, 1985). Using confirmatory factor analyses in R (lavaan package; Rosseel, 2012), two models of motivational regulation were calculated and compared following the methodology used in previous studies (Thomas et al., 2018; Vansteenkiste et al., 2010). Specifically, a 2-factor model comprising self-determined (intrinsic and identified) and externally determined motivational regulation (introjected and external) was tested against a 4-factor model comprising the four investigated motivational regulations as factors (see Table 3). Yuan-Bentler correction was applied to handle the multivariate non-normality (e.g. Yuan & Bentler, 1998). Links between error variances were incorporated into the analysis that were suggested by the modification indices and are consistent with theoretical and empirical assumptions. Specifically, the model was augmented with suggested links between items that form the same latent variable (items 5 and 6; items 8 and 9) and suggested links between the items that assess self-determined motivational regulation (items 2 and 4; items 3 and 4; see Thomas et al., 2018; Vansteenkiste et al., 2010).

The Standardized Root Mean Square Residual (SRMR), the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI) were used as fit indices (Hu & Bentler, 1999; Kline, 2015; Moosbrugger & Schermelleh-Engel, 2012). For the SRMR, values below .05 are considered to show a good model fit, whereas values below .10 indicate an acceptable model fit (Kline, 2015). For the RMSEA, values below .05 indicate a good model fit, while values below .08 show an acceptable model fit (Moosbrugger & Schermelleh-Engel, 2012). For the comparative fit indices, CFI- and TLI-values above .95 indicate a good model fit, while values above .90 are considered to show an acceptable model fit (Hu & Bentler, 1999; Moosbrugger & Schermelleh-Engel, 2012). The Bayesian Information Criterion (BIC) was used to compare the two models, with the model with the lowest BIC value being the most appropriate (Penny et al., 2007).

The same thresholds and the same R package were applied for the structural equation model that was subsequently examined. Again, the Yuan-Bentler correction was applied to deal with the multivariate non-normality (e.g. Yuan & Bentler, 1998). In this model, autonomy need satisfaction and frustration were investigated as predictors of the motivational regulations regarding birdwatching. Pearson correlations between the motivational regulations and different birding behaviors were calculated using IBM SPSS Statistics 29.

As additional analyses, differences in the motivational regulation and birding behaviors of birdwatchers with different skill levels (novice, intermediate, expert; comparable to Kruger & Viljoen, 2023) were investigated. Analyses of variance with subsequent post hoc tests were calculated for this purpose. Games-Howell post hoc tests were used, as homogeneity of variance was not given for the investigated variables. Due to the different group sizes, the effect size was corrected according to Hedges (Hedges *g*; see Hedges & Olkin, 1985). Due to multiple tests, the alpha level was adjusted according to Bonferroni (VanderWeele & Mathur, 2019).

Results

Motivational regulation

First, we employed confirmatory factor analysis to examine the two depicted models of self-determined and externally determined motivational regulation (Table 4). For the 2-factor model, none of the examined fit indices reached the recommended thresholds. The values for the SRMR (< .05), the RMSEA (< .05) as well as the CFI and TLI (both > .95) indicated a good fit for the 4-factor model.

Table 3 depicts the items of the 4-factor model with their respective statistics. The factor loadings of the items were sufficient (λ between .466 and .888). Overall, the scales yielded sufficient to good internal consistency. The configural model, which depicts the assumed correlations before the analyses, as well as the structural model, which depicts the existing and further correlations that became apparent in the analyses are presented in Figure 1.

Looking at the descriptive statistics, it can be seen that the agreement with the items measuring self-determined motivational regulation was higher than the agreement with the externally determined motivational regulation (Table 3). Moreover, the following correlations were found between the four motivational regulations (Table 5): The strongest positive correlation occurred between the two externally determined motivational regulations (introjected and external). A small positive correlation was found between the self-determined motivational regulations (intrinsic and identified).

Table 4. Chi square statistics, fit indices, and values for the comparison of the two tested models.

Model	χ^2	*df*	SRMR	RMSEA	CFI	TLI	BIC
2-Factor Model	283.69**	49	.103	.093	.861	.813	18157.69
4-Factor Model	92.08**	44	.034	.045	.971	.957	17997.35

Note. ** $p < .01$; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; BIC = Bayesian Information Criterion.

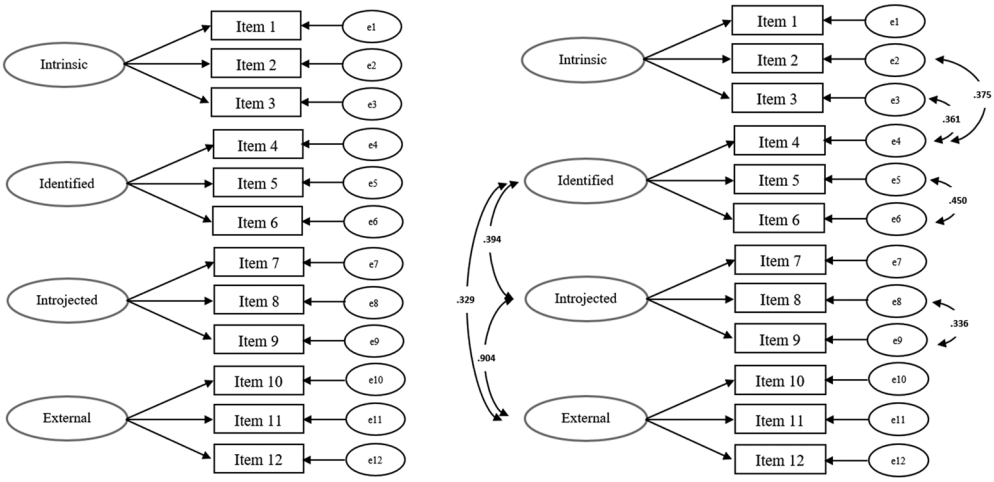

Figure 1. Configural model (left side) and structural model (right side) of the four motivational regulations. Although not displayed, correlations between the latent variables were part of the configural model. Only significant paths are displayed in the structural model. The circles with the letter e represent the measurement error of each item.

For identified regulation, small positive correlations with the two externally determined motivational regulations were found.

Lastly, we examined whether there are differences in motivational regulation between birdwatchers with different skill levels (Table 6). Analyses of variance revealed differences between the three investigated groups (novice, intermediate, expert) in identified regulation ($F(2, 559) = 67.12$, $p = .000$, $\eta^2 = .19$) with a large effect size. Subsequent post hoc tests showed significant differences between the three investigated groups in favor of those with the higher skill level. No significant differences were found for the other three motivational regulations (intrinsic: $F(2, 559) = 0.68$, $p = 1.000$, $\eta^2 = .00$; introjected: $F(2, 559) = 0.47$, $p = 1.000$, $\eta^2 = .00$; external: $F(2, 559) = 3.49$, $p = 1.000$, $\eta^2 = .01$). The reported p-values were adjusted according to Bonferroni due to multiple testing.

Table 5. Correlations between birding motivation and birding behaviors.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1 Intrinsic regulation	–											
2 Identified regulation	**.09***											
3 Introjected regulation	.05	**.22****										
4 External regulation	.03	**.20****	**.59****									
5 Number of days birdwatching per year	.05	**.31****	.03	**.13****								
6 NABU bird count	**.09***	**.17****	.07	**.09***	**.11****							
7 Breeding and waterbird count	.04	**.44****	.06	.04	**.21****	**.08***						
8 Ringing programs	.02	**.25****	**.09***	**.11****	**.15****	**–.10***	**.26****					
9 Nest box caretaking	.01	**.08***	**.22****	.04	.02	**.14****	**.20****	**.23****				
10 Participation in a bird race	–.01	**.18****	**.21****	**.38****	**.17****	**.04**	**.29****	**.20****	.06			
11 Participation in a field trip	.04	–.03	.08	.06	–.05	**.20****	–.01	–.08	.06	–.06		
12 Leading an excursion or giving a presentation	.03	**.36****	.07	.05	**.25****	.06	**.43****	**.22****	**.30****	**.27****	–.07	
13 Number of reported observations per year	.00	**.45****	**.14****	**.27****	**.49****	**.13****	**.39****	**.19****	**.15****	**.35****	–.07	**.30****

Note. * $p < .05$, ** $p < .01$; significant correlations are highlighted in bold; scales ranged from 1 to 5 except for the number of reported observation (scale from 1 to 9).

Table 6. Means and standard deviations of the investigated motivational regulations differentiated by skill level as well as the results of the post hoc analyses for the comparison of different skill levels.

	(1) Novice (n = 100)	(2) Intermediate (n = 216)	(3) Expert (n = 246)	Post hoc analyses		
Variables	*M (SD)*	*M (SD)*	*M (SD)*	(1) vs. (2)	(2) vs. (3)	(1) vs. (3)
Intrinsic Regulation	4.19 (0.68)	4.28 (0.71)	4.28 (0.65)	---	---	---
Identified Regulation	2.69 (1.00)	3.23 (0.96)	3.88 (0.84)	**$M_{diff} = -0.54$** **$SE = 0.12$** **$p = .000$** **$g = 0.56$**	**$M_{diff} = -0.65$** **$SE = 0.08$** **$p = .000$** **$g = 0.72$**	**$M_{diff} = -1.19$** **$SE = 0.11$** **$p = .000$** **$g = 1.34$**
Introjected Regulation	1.92 (0.85)	2.00 (0.87)	2.02 (0.92)	---	---	---
External Regulation	1.54 (0.68)	1.69 (0.76)	1.78 (0.78)	---	---	---

Note. Rating scale ranging from 1 = "totally disagree" to 5 = "totally agree"; Novice = skills rated with 1 or 2, Intermediate = skills rated with 3, Expert = skills rated with 4 or 5, rating scale for assessing skills: 1 (novice) to 5 (expert); If the analysis of variance yielded no significant results, no post hoc tests were calculated. Significant results are printed in bold. p-values are adjusted according to Bonferroni.

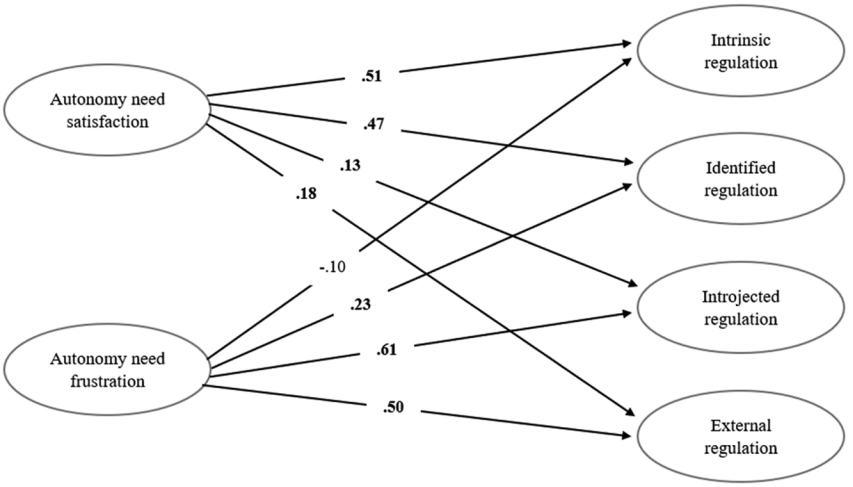

Figure 2. Structural equation model including autonomy need satisfaction and frustration as predictors of the four motivational regulations. Significant standardized regression weights ($p < .05$) are highlighted in bold. Although the manifest variables are not shown here, they were included in the model.

Need for autonomy and motivational regulation

Subsequently, autonomy need satisfaction and frustration were examined as antecedents of the four types of motivational regulation. The tested model, with all investigated paths, is depicted in Figure 2.

The fit indices indicated an acceptable model fit, except for the RMSEA that reached the threshold for a good model fit (χ^2 = 230.92**; df = 113; SRMR = .050; RMSEA = .046; CFI = .949; TLI = .931). Significant paths were found between autonomy need satisfaction and all motivational regulations, with notably higher regression weights for the paths to the self-determined than externally determined types of motivation. For autonomy need frustration, the paths were significant for all motivational regulations except intrinsic regulation. Regression weights were higher for the externally determined than for the self-determined motivational regulations. Descriptively speaking, autonomy need satisfaction during birdwatching was more pronounced than autonomy need frustration (M_S = 3.97, SD_S = 0.74; M_F = 1.53, SD_F = 0.72).

Birding behavior

Preliminary, we took a closer look at the descriptive statistics regarding the investigated birding behaviors (Table 7). On average, the birdwatchers surveyed pursued their hobby on 31–70 days in the last year. The mean number of reported observations was found to be between 101 and 200 per year. The remaining birding behaviors that were studied can be listed in the following order, starting with the most frequently performed: NABU bird count, breeding and waterbird count, leading an excursion or giving a presentation, nest box caretaking, participation in a field trip, participation in a bird race, and ringing programs. These activities were carried out between one and three times on average. As expected, less demanding birding behaviors were followed more frequently than more demanding birding behaviors.

Table 7. Means, standard deviations, median, and range of the investigated birding behaviors.

Variables	*M*	*SD*	*Md*	Range (*Min–Max*)
I) Number of days birdwatching per year	4.13	1.22	4.00	1–6
II) NABU bird count	2.67	1.25	3.00	1–5
III) Breeding and waterbird count	2.51	1.63	2.00	1–5
IV) Ringing programs	1.49	1.08	1.00	1–5
V) Nest box caretaking	2.27	1.44	2.00	1–5
VI) Participation in a bird race	1.53	0.92	1.00	1–5
VII) Participation in a field trip	2.17	1.53	2.00	1–5
VIII) Leading an excursion or giving a presentation	2.43	1.33	1.00	1–5
IX) Number of reported observations per year	4.78	2.84	5.00	1–9

Note. Rating scales: (I) 1 (none), 2 (1–10), 3 (11–30), 4 (31–70), 5 (71–200), 6 (> 200); (II–VIII) 1 (never), 2 (1), 3 (2–4), 4 (5–10), 5 (> 10); (IX) 1 (none), 2 (1–10), 3 (11–50), 4 (51–100), 5 (101–200), 6 (201–500), 7 (501–1000), 8 (1001–2000), 9 (> 2000).

In addition to the frequency with which all the birdwatchers studied performed the behaviors, we examined the frequency separately for different skill levels (Table 8). This descriptive analysis shows that some birding behaviors are performed with similar frequency among birdwatchers of all three skill levels, such as participating in a field trip. Moreover, some behaviors are performed more frequently by intermediate and expert birdwatchers than by novice birdwatchers, such as nest box caretaking. At the same time, some behaviors are performed more often by expert birdwatchers than by novice and intermediate birdwatchers, such as leading an excursion or giving a presentation. This activity is performed least frequently by novices. Expert birdwatchers are least likely to engage in ringing programs. However, the performance of this activity is low among birdwatchers of all investigated skill levels.

Analyses of variances revealed significant differences between the three investigated groups (novice, intermediate, expert) in all birding behaviors except the NABU bird count and participation in a field trip. For the breeding and waterbird count, leading an excursion or giving a presentation, and the number of reported observations, subsequent post hoc tests were significant for all group comparisons. The comparison between novice and expert birdwatchers was significant for ringing programs and nest box caretaking. Regarding participation in a bird race, only the comparison between novice and intermediate birdwatchers was not significant. Significant differences in the number of days spent birdwatching could not be found in the comparison of intermediate and expert birdwatchers. All significant comparisons are in favor of the group with the higher skill level.

Motivational regulation and birding behavior

For intrinsic regulation ($M = 4.26$; $SD = 0.68$), no significant correlation could be found with the investigated birding behaviors except for the small positive correlation with the NABU bird count (Table 5). Identified regulation ($M = 3.42$; $SD = 1.02$) correlated positively with all behaviors except for participation in a field trip. The strongest correlations for identified regulation were found with the breeding and waterbird count and the reported observations. Regarding introjected regulation ($M = 1.99$; $SD = 0.89$), small, yet significant positive correlations could be found with ringing programs, nest box caretaking, participation in a bird race, and the reported observations. Last, the days of birdwatching, NABU bird count, ringing programs, participation in a bird race, and the reported observations correlated positively with external regulation

Table 8. Means and standard deviations of the investigated birding behaviors differentiated by skill level as well as the results of the analyses for the comparison of different skill levels.

Variables	(1) Novice (n = 100) *M (SD)*	(2) Intermediate (n = 216) *M (SD)*	(3) Expert (n = 246) *M (SD)*	Analyses of variance	Post hoc analyses (1) vs. (2)	Post hoc analyses (2) vs. (3)	Post hoc analyses (1) vs. (3)
I) Number of days birdwatching per year	3.18 (1.24)	4.15 (1.14)	4.50 (1.07)	**$F(2, 559) = 48.28$ $p = .000$ $\eta^2 = .15$**	**$M_{diff} = -0.97$ $SE = 0.15$ $p = .000$ $g = 0.83$**	$M_{diff} = -0.35$ $SE = 0.10$ $p = .089$ $g = 0.32$	**$M_{diff} = -1.23$ $SE = 0.14$ $p = .000$ $g = 1.18$**
II) NABU bird count	2.39 (1.15)	2.71 (1.17)	2.75 (1.35)	$F(2, 559) = 3.12$ $p = 1.000$ $\eta^2 = .01$	---	---	---
III) Breeding and waterbird count	1.46 (1.02)	2.33 (1.52)	3.10 (1.67)	**$F(2, 559) = 44.23$ $p = .000$ $\eta^2 = .14$**	**$M_{diff} = -0.87$ $SE = 0.15$ $p = .000$ $g = 0.63$**	**$M_{diff} = -0.77$ $SE = 0.15$ $p = .000$ $g = 0.48$**	**$M_{diff} = -1.64$ $SE = 0.15$ $p = .000$ $g = 1.09$**
IV) Ringing programs	1.18 (0.64)	1.39 (0.99)	1.70 (1.24)	**$F(2, 559) = 10.00$ $p = .002$ $\eta^2 = .04$**	$M_{diff} = -0.21$ $SE = 0.09$ $p = 1.000$ $g = 0.24$	$M_{diff} = -0.31$ $SE = 0.10$ $p = .349$ $g = 0.27$	**$M_{diff} = -0.52$ $SE = 0.10$ $p = .000$ $g = 0.47$**
V) Nest box caretaking	1.73 (1.09)	2.20 (1.41)	2.54 (1.52)	**$F(2, 559) = 12.14$ $p = .000$ $\eta^2 = .04$**	$M_{diff} = -0.47$ $SE = 0.15$ $p = .132$ $g = 0.36$	$M_{diff} = -0.34$ $SE = 0.14$ $p = 1.000$ $g = 0.23$	**$M_{diff} = -0.81$ $SE = 0.15$ $p = .000$ $g = 0.58$**
VI) Participation in a bird race	1.25 (0.56)	1.37 (0.75)	1.79 (1.10)	**$F(2, 559) = 18.37$ $p = .000$ $\eta^2 = .06$**	$M_{diff} = -0.12$ $SE = 0.08$ $p = 1.000$ $g = 0.17$	**$M_{diff} = -0.41$ $SE = 0.09$ $p = .000$ $g = 0.44$**	**$M_{diff} = -0.54$ $SE = 0.09$ $p = .000$ $g = 0.55$**
VII) Participation in a field trip	2.47 (1.22)	2.55 (1.37)	2.31 (1.32)	$F(2, 559) = 1.98$ $p = 1.000$ $\eta^2 = .01$	---	---	---
VIII) Leading an excursion or giving a presentation	1.17 (0.68)	1.72 (1.25)	2.97 (1.60)	**$F(2, 559) = 83.02$ $p = .000$ $\eta^2 = .23$**	**$M_{diff} = -0.55$ $SE = 0.11$ $p = .000$ $g = 0.50$**	**$M_{diff} = -1.25$ $SE = 0.13$ $p = .000$ $g = 0.86$**	**$M_{diff} = -1.80$ $SE = 0.12$ $p = .000$ $g = 1.29$**
IX) Number of reported observations per year	2.69 (2.03)	4.45 (2.65)	5.92 (2.73)	**$F(2, 559) = 58.39$ $p = .000$ $\eta^2 = .17$**	**$M_{diff} = -1.76$ $SE = 0.27$ $p = .000$ $g = 0.71$**	**$M_{diff} = -1.47$ $SE = 0.25$ $p = .000$ $g = 0.55$**	**$M_{diff} = -3.23$ $SE = 0.27$ $p = .000$ $g = 1.27$**

Note. Rating scales: (I) 1 (none), 2 (1–10), 3 (11–30), 4 (31–70), 5 (71–200), 6 (> 200); (II–VIII) 1 (never), 2 (1), 3 (2–4), 4 (5–10), 5 (> 10); (IX) 1 (none), 2 (1–10), 3 (11–50), 4 (51–100), 5 (101–200), 6 (201–500), 7 (501–1000), 8 (1001–2000), 9 (> 2000); Novice = skills rated with 1 or 2, Intermediate = skills rated with 3, Expert = skills rated with 4 or 5, rating scale for assessing skills: 1 (novice) to 5 (expert); If the analysis of variance yielded no significant results, no post hoc tests were calculated. Significant results are printed in bold. *p*-values are adjusted according to Bonferroni.

($M = 1.70$; $SD = 0.76$). The strongest correlation for external regulation was found with participation in a bird race, followed by the reported observations.

The correlation between participation in a bird race and the reported observations was found to be strong, not only with external regulation, but also with each other. The strongest correlation was found between the reported observations and the number of days spent birdwatching. The reported observations also correlated with all other

birding behaviors except for the participation in a field trip. The latter showed only a weak correlation with the NABU bird count. Strong correlations were also found between leading an excursion or giving a presentation and the other more complex behaviors, including breeding and waterbird count as well as nest box caretaking. The only significant negative, yet small correlation that was found was between the NABU bird count and ringing programs. Apart from this correlation, all reported significant correlations between the investigated birding behaviors were positive.

Discussion

The current study aimed at gaining a deeper understanding of self-determined and, especially, externally determined motivational regulations regarding the leisure activity of birdwatching (*research desideratum 1*), with an additional consideration of the antecedents (*research desideratum 2*) and outcomes (*research desideratum 3*) of these regulations. For this purpose, the perspective of self-determination theory (Ryan & Deci, 2017) was taken. The following sections present a discussion of the research desiderata addressed in the present study.

Motivational regulation during birdwatching (research desideratum 1)

Since previous studies in the context of leisure physical activity (Tilga et al., 2020; Tsorbatzoudis et al., 2006) and on basic psychological need frustration during birdwatching (Großmann & Randler, 2025) suggest that extrinsic motivation can occur during birdwatching, a detailed examination of motivational regulation during this leisure activity was warranted. In contrast to other motivation theories, self-determination theory offers a detailed perspective on self-determined and externally determined motivational regulation, particularly in the context of extrinsic motivation (Ryan & Deci, 2017).

Our data suggest the existence of four distinct motivational regulations during birdwatching. In line with previous studies, our data confirmed a 4-factor model with intrinsic, identified, introjected, and external motivational regulation (see Thomas et al., 2018; Thomas & Müller, 2016). The model fit indices all indicated a good model fit (Hu & Bentler, 1999; Kline, 2015; Moosbrugger & Schermelleh-Engel, 2012). In addition, the comparison with the 2-factor model showed that a differentiation between self-determined and externally determined (Thomas et al., 2018; Vansteenkiste et al., 2010) is not sufficient to describe the motivational regulations associated with birdwatching. In terms of content, this indicates that birdwatching is not solely driven by the intrinsic enjoyment of the activity itself, but by external factors such as competition, the desire for recognition from others, and a sense of contribution to socially relevant topics such as conservation (see DeCaro & Stokes, 2008; Larson et al., 2020; Randler & Großmann, 2022a; Sullivan et al., 2014).

In the context of leisure activities, this differentiated perspective on motivation was rarely adopted, for instance, in the area of leisure physical activity. In a study conducted by Kalajas-Tilga et al. (2020), the same factorial structure was identified for the motivational regulation concerning this leisure activity. As was the case in the current study, they also found lower agreement with externally than self-determined

motivational regulation (Kalajas-Tilga et al., 2020; see also Thomas et al., 2018). This suggests that leisure activities are primarily driven by self-determined rather than externally motivational regulation, which is to be expected in the context of self-chosen activities (Iso-Ahola & Baumeister, 2023). However, comparisons with the results of studies in the area of leisure physical activity must be viewed with caution because each leisure activity possesses specific characteristics that can, for example, influence the expression of the different motivational regulations. For instance, some leisure physical activities may be inherently more competitive than birdwatching. However, competitive events do exist in the domain of birdwatching, including bird races and birdathons (Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022b), in which birdwatchers apparently participate due to external incentives (Table 3).

It must be acknowledged that even if externally determined regulations are present to a lesser degree during birdwatching than self-determined ones (Table 3), these motivational regulations should be taken into account when investigating birdwatching for the following reasons: The presence of externally determined regulations to a minor degree has the potential to negatively impact well-being and recreation (see Ryan & Deci, 2017). This impairment occurs in particular when externally determined regulations are not aligned with self-determined regulations. It is therefore necessary to examine in detail both externally determined regulations and the combination of externally determined and self-determined regulations. Based on this comprehensive understanding of externally determined motivational regulation in birdwatching, measures that reduce such regulations could be developed to enable optimum well-being and recreation during birdwatching (see Ryan & Deci, 2017). However, this does not mean that competitive events should no longer take place, but rather that these events and other birdwatching activities should not focus on external incentives.

Aside from the fit indices, it is also important to address the reliability of the test instrument. In some cases, the reliability is low (see Kalajas-Tilga et al., 2020), which may be attributed to the relatively low factor loadings of two items (items 3 and 12). Upon examination of the content of these two items, it becomes evident that they exhibit notable differences to the two other items of the respective subscales. For example, birdwatching due to the esthetics and fascination of the birds (items 1 and 2) may be accompanied by enjoying the activity (item 3); however, these experiences may still represent different intrinsic qualities. Further development of the test instrument may be achieved by increasing the item battery or testing other formulations of the items.

Finally, the correlations between the factors should be discussed. It can be seen that the self-determined identified regulation correlated positively with the two externally determined regulations, although this correlation was lower than the correlation between the externally determined motivational regulations (see Thomas et al., 2018; Thomas & Müller, 2016). There may be three reasons for this: First, these factors might be positively correlated with each other because, in contrast to intrinsic regulation, they represent the pursuit of a goal that is separable from the action. Second, the measured external motives may also be based on personal meaningfulness. For example, the goal of having the longest possible list could be pursued in order to contribute to conservation. Such assumptions would need to be further explored in future studies. Third, it should be noted that the test instrument does not distinguish

between the approach and avoidance dimensions of introjected regulation, which are under discussion (Assor et al., 2009). As in previous test instruments, one dimension was selected, the approach dimension (see Thomas et al., 2018). In contrast to the avoidance dimension, the approach dimension can have positive effects on behavior and be associated with well-being (Assor et al., 2009). The positive correlation with the identified regulation lends credence to this assumption. In future studies, items assessing the avoidance dimension can be formulated and tested in addition to the approach dimension applied in this study (see Martinek et al., 2021). However, it should be noted that increasing the complexity of the model by adding items might affect the fit indices negatively (Kenny & McCoach, 2003; Shi et al., 2019).

Motivational regulation and the need for autonomy (research desideratum 2)

The present study employed a structural model to examine two key predictors of motivational regulation. In accordance with self-determination theory and studies in the context of leisure (Kalajas-Tilga et al., 2020; Tilga et al., 2020), we discovered that autonomy need satisfaction was a stronger predictor of self-determined than externally determined regulations, whereas externally determined motivational regulations were more strongly predicted by autonomy need frustration. Apart from theoretical assumptions and previous empirical findings, these significant paths reveal that birdwatchers who engage in competition, seek recognition from others, and need to prove their skills to themselves experience pressure and limited autonomy (see Großmann & Randler, 2025). Moreover, these birdwatchers seem to feel that they are acting in accordance with the expectations of others (see Großmann & Randler, 2025). This combination of autonomy need frustration and externally determined regulation in leisure activities is likely to lead to ill-being rather than well-being and recreation (see Ryan & Deci, 2017). Concerning autonomy need satisfaction, enjoying birds and nature as well as gathering data for society and experiencing a sense of meaningfulness seem to be the result of experiencing choice, following one's own interests, and being able to express one's true self (see Großmann & Randler, 2025; Reeve, 2018; Ryan & Deci, 2017).

Besides these valuable insights into the antecedents of motivational regulation in birdwatching, these results that are congruent with existing theory and prior empirical findings suggest the criterion validity of our test instrument. This also applies to the correlations found between motivational regulation and birding behaviors, which will be discussed in the following section.

Motivational regulation and behavior (research desideratum 3)

We gained some important insights with the investigation of the relationships between motivational regulations and birding behaviors. No correlations were identified between intrinsic regulation, and the behaviors under investigation except for a weak correlation with the NABU bird count. A more detailed examination of these behaviors suggests that they may be driven by goals that are separable from the act of birdwatching itself. A correlation with participation in a field trip could have been expected, as intrinsic goals may be primarily pursued *via* such trips. However, it should be noted that field

trips can be more or less demanding (see Maake et al., 2022; Murawiec et al., 2021) and thus may be based on different motivational regulations, including those that are externally determined. For instance, a birdwatcher may wish to gain recognition from the other participants on the field trip or expand his/her list of birds seen.

Focusing on counting behaviors, it can first be stated that the NABU bird count correlated not only with intrinsic regulation, but also with identified and external regulation. It is likely that a birdwatcher has recognized the importance of this behavior, is motivated to collect important data for nature conservation, and therefore engages in this activity in an identified manner (see Vallerand & Ratelle, 2002; Ryan & Deci, 2017; Table 1). The correlations further suggest that external goals, such as the extension of the list or competition, exert an influence on this count. However, the extent to which one can extend the list when observing birds in one's yard/garden is questionable. This could be more the case if a birdwatcher takes part in more demanding counts such as the breeding and waterbird count investigated in the current study (see Atkinson et al., 2006; Randler, 2022). However, the correlations indicate that these birding behaviors are predominately associated with self-determined regulation, namely identified regulation. Since this regulation comprises goals, such as gathering data for nature conservation projects and contributing to society, this finding is hardly surprising. The results suggest that birdwatchers are particularly inclined to exert effort if they see personal meaningfulness in these activities (see Vallerand & Ratelle, 2002; Ryan & Deci, 2017; Table 1). This personal meaningfulness leads to more observations being reported and more days spent birdwatching per year as well.

Likewise, the more demanding activities, such as taking part in ringing programs, leading an excursion, or giving a presentation were found to be strongly correlated with identified regulation. In light of these findings, it can be posited that these activities are also related to personal significance and the contribution to society and nature conservation (see Vallerand & Ratelle, 2002; Ryan & Deci, 2017; Table 1). Externally determined regulation seems to play a rather subordinate role in this context. The situation is different for the activity caretaking of nest boxes, for which similar correlations could have been anticipated. However, the correlation found with introjected regulation suggests that recognition from others is desired and that the birdwatchers wish to prove something to themselves during these activities (see Assor et al., 2009; Ryan & Deci, 2017; Table 1).

As anticipated, participation in a bird race or birdathon is predominantly driven by external motives, such as generating the longest possible list, winning a competition, or gaining recognition from other birdwatchers (see Connell, 2009; Kaufman, 2005; Randler & Großmann, 2022b). However, this birding behavior seems to be linked to personal meaningfulness as well. This could be due to the fact that the data collected in these competitions can contribute to societal improvement and nature conservation. The correlations between participation in a bird race and reported observations as well as between identified and external regulation lend credence to this assumption.

Lastly, besides the strong correlations with identified regulation, the activities measured in terms of quantity exhibited a significant correlation with the externally determined regulations. The correlations suggest that the number of days spent birdwatching per year are accompanied by gaining recognition and proving one's skills. However, personal meaningfulness and the desire to contribute to society and nature

conservation seem to be more powerful motivators for spending days birdwatching and reporting observations. In contrast to the number of days spent birdwatching, reporting one's observations seems to be driven by generating the longest possible list and winning competitions as well.

Due to their significance for citizen science initiatives and nature conservation, the current findings are discussed from this perspective in conclusion. Two findings merit particular attention with regard to these activities. Among the birdwatchers studied, the motivation to contribute to the knowledge of birds in science and society, as well as to collect data for nature conservation projects, was found to be only moderately strong (items 5 and 6; Table 3). Concurrently, the correlations indicate that bird counts and reported observations are primarily driven by an identified and external motivational regulation (see Table 5). This suggest that even individuals who already pursue the hobby may be further motivated to participate insuch activities. The findings reveal that two measures may positively influence participation in these activities: emphasizing the personal and social significance of engaging with these topics and performing these activities, as well as using rewards (Reeve, 2018; Ryan & Deci, 2017; see Table 1). However, if rewards elicit external motivational regulation, the performance of the activities will probably cease when the reward is no longer present (see Ryan & Deci, 2017). To achieve sustainable engagement in citizen science initiatives and nature conservation, it is necessary to emphasize the personal significance of these activities and evoke appreciation for them. These assumptions are in line with the findings of a study by Maund et al. (2020). The participants in citizen science activities examined in their study stated that they took part in these activities in particular because of the intrinsic value for the environment and the associated knowledge acquisition (Maund et al., 2020).

It is important to note that citizen science activities are designed for the general public and should also appeal to individuals who, unlike the participants in this study, lack experience in activities such as birdwatching. The reasons why these individuals would participate in such projects or what would motivate them to participate could be investigated in future studies. The study by Maund et al. (2020) demonstrated that even individuals who only contribute data occasionally cite intrinsic value for the environment and knowledge acquisition as motives for their participation. Therefore, emphasizing personal significance and evoking appreciation could also be an effective method to motivate individuals with less experience. Wright et al. (2015) assume that participants primarily take part in citizen projects if these projects are aligned with the motives they are pursuing. The test instrument we developed can be used to design projects in such a differentiated way by assessing and analyzing the motivational regulation of the target population prior to design. At the same time, our findings provide important information on the differences in motivational regulation between birdwatchers with different skill levels. Differences can be found in the sample we investigated, particularly in the identified motivational regulation, which could be considered in the design of citizen science projects. When looking at these differences, it becomes apparent that novice and intermediate birdwatchers are less likely to say that they engage in birdwatching because they find this activity personally important and want to contribute to conservation projects than expert birdwatchers.

Further implications that can be derived from our findings concern the differences we found in the birding behaviors of birdwatchers with different skill levels. These

findings show that the report of observations and participation in breeding and waterbird counts could be promoted amongst novice and intermediate birdwatchers compared to expert birdwatchers. It should be noted here that the lower report of observations might be attributed to the smaller number of days spent birdwatching by these two types of birdwatchers compared to expert birdwatchers. Participation in ringing programs and nest box caretaking could be encouraged among novice birdwatchers. The low participation in these programs and activities across all skill levels could, for instance, be attributed to availability near the place of residence.

Limitations and implications

Despite the promising results of the current study, some further limitations need to be addressed. First, it needs to be pointed out that our study is cross-sectional. Designs such as experimental and longitudinal approaches could be used in future studies to further test the validity of the test instrument and to be able to establish causal relationships between basic psychological need satisfaction and frustration and motivation as well as motivation and behavior. Moreover, experimental, or quasi-experimental studies could be conducted to investigate whether interventions can promote self-determined qualities of birdwatching motivation and, consequently, conservation activities. The basic psychological needs should be considered when designing such interventions (see DeCaro & Stokes, 2008; Großmann & Randler, 2025; Walker & Kono, 2018).

Secondly, it should be noted that the items assessing motivational regulation during birdwatching were not pretested, as would be necessary for scale development (see Willis, 2016). We decided against pretesting because the majority of the items had already been tested in previous studies (Martinek et al., 2021; Randler & Großmann, 2022a; Thomas et al., 2018). These studies, in addition to the current study, offer insights into the validity of the measure developed. It can be reasonably assumed that the items used in the current study are sufficiently reliable and valid. The characteristic values of the applied items lend credence to this assumption (Table 3). Three new items had to be formulated to assess external regulation, as external incentives can vary depending on the context. However, the characteristic values of these items are sufficient for our analyses (e.g. factor loadings). A single relatively low factor loading was identified, which presumably contributed to the comparatively low reliability of this subscale (Table 3). For future studies utilizing these items, we suggest that additional external incentives within the context of birdwatching might be incorporated, which could be identified in advance through an exploratory study. It is possible that some external incentives that motivate birdwatchers have not yet been identified in previous studies.

Thirdly, we did not include the birding behaviors in the structural equation model for the investigation of the antecedents of motivational regulation for two reasons. First, the inclusion of a large number of additional variables, which would increase the complexity of the model, may have resulted in a negative impact on the fit indices, potentially leading to the identification of an unacceptable model (Kenny & McCoach, 2003; Shi et al., 2019). Secondly, the relationships between the motivational regulations and birding behaviors could not be predicted with any degree of certainty (see section

"birdwatching motivation and birding behavior"). Consequently, we elected to examine these relationships in an explorative manner. Future studies might combine the behaviors based on our data and include these combined variables in a structural equation model.

Fourthly, about the sample recruitment process, it should be noted that not all of the organizations contacted posted our survey call on their website or distributed it to their members by mail. This may have biased the data. However, given the wide reach of these websites and mailing lists, we believe that a representative sample could potentially have been reached. Although we did not contact the *Dachverband Deutscher Avifaunisten* (DDA), we did contact its member associations. Of these, we contacted 16 nationwide associations. In the end, associations from eastern Germany, northern Germany, and southern Germany participated, which can be considered representative. Of the approximately 10,000 people represented by the DDA (*Dachverband Deutscher Avifaunisten* [DDA], 2024), about 5% took part in this study, which further supports the assumption of representativeness. At the same time, some characteristics of our sample lend credence to this assumption. For instance, our sample description shows a wide range in terms of age and a high proportion of participants with a university degree, which is representative for birdwatchers (Großmann & Randler, 2025; Özkan, 2023; Randler, 2023). In addition, the participants in the current study are broadly distributed in terms of the birding behaviors investigated and the frequency with which they perform them. Regarding these behaviors, it can be seen that, as expected, more demanding activities (e.g. ringing programs) are reported by fewer participants than less demanding activities (e.g. NABU bird count). It can therefore be assumed that the sample examined is representative with regard to these characteristics.

Nonetheless, it should be noted that especially birdwatchers who have a strong interest in their hobby and are intrinsically motivated to pursue their hobby may have completed the survey. This assumption is supported by the descriptive statistics of the motivational variables and the skills of the sample studied. Specifically, the participants showed a high level of agreement with self-determined motivational regulations, a low level of agreement with externally determined motivational regulations, and relatively high skills (identification of birds by appearance and sound; Table 2). If highly interested and self-determined motivated birdwatchers in particular participated in our survey, the data may be biased and the representativeness of our findings may be limited. This possible bias could be due to the recruitment process. Individuals who visit the websites of ornithological organizations and are subscribed to the mailing lists of these organizations are likely to have a special interest in birdwatching, pursue this hobby based on self-determined motivation, and receive a lot of information about their hobby, so they may also have a high level of skills. On the other hand, the agreement with the motivational regulations that we found in our study may be representative for birdwatchers. Studies in the context of other leisure activities, in which externally determined motivational regulation was also found to be less pronounced than self-determined motivation (see Kalajas-Tilga et al., 2020), lend credence to this assumption.

It is recommended that such assumptions need to be tested in future studies. In these studies, participants who are assumed to be regulated in an externally determined manner (e.g. birdathon participants) could be the subject of a more targeted

investigation. Moreover, it would be beneficial to place a special focus on less proficient birdwatchers. It is important to note, however, that these birdwatchers do not regularly visit ornithological websites and may not be registered in the mailing lists of ornithological organizations. Maybe, birdwatchers who participate in the less demanding NABU bird count could be approached or the call for participating in the survey could be distributed during field trips. Care should be taken here to ensure that the call for participation is specifically addressed to novices. In the current study, we ensured that all birdwatchers felt included; however, it may be advantageous to emphasize this even more clearly.

Lastly, it is important to consider the potential for cultural differences to limit the generalizability of this study, which focused on birdwatchers from German-speaking countries. These differences may be particularly relevant with respect to three types of motives examined in this study. First, the act of contributing to nature conservation may be subject to cultural differences, as the importance attributed to this conservation may vary across cultural contexts. Evidence for this supposition is provided by the Nature Conservation Index, which shows that there are differences in conservation efforts between the 180 countries surveyed (BioDB, 2024). Secondly, cultural differences may influence the expression of introjected and external competitive motives. For example, these motives might be pronounced differently in collectivistic countries compared to individualistic countries (see Hofstede et al., 2010). Thirdly, cultural differences may be found in the external motive to win bird races. This motive could be affected by whether bird races are hosted in a country as well as by the importance attributed to these races in the birdwatcher community in the respective country. Future studies could investigate birdwatchers in different countries and compare their motives or the manifestation of these motives. The instrument presented in this study could be employed in such studies.

Conclusion

This study was dedicated to answering open questions regarding birdwatching motivation. Our study offers a novel approach to examining motivation during this leisure activity, providing a more differentiated perspective and deeper insights into this phenomenon. Our findings indicate that autonomy need frustration and externally determined motivational regulation are present in birdwatching activities; however, to a lesser extent than autonomy need satisfaction and self-determined motivational regulation. Moreover, our results suggest that self-determined and externally determined goals pursued during birdwatching can result in disparate birdwatching behaviors. It is encouraging to note that the majority of these activities are regulated in an identified manner, driven by the desire to make a meaningful contribution to society and the conservation of nature.

The results of our study offer preliminary evidence supporting the validity of the developed test instrument; however, further investigation is necessary to address the limitations of the study. Once these limitations have been adequately addressed, our test instrument will be well-suited for an adaptation to other leisure activities and languages. Regarding the externally determined motivational regulations found, future studies may investigate how birdwatchers can be motivated in a self-determined way

to experience well-being and recreation in pursuing their hobby and to engage in conservation (see Randler & Großmann, 2022a; Ryan & Deci, 2017). Nature-related activities can contribute to conservation in a way that scientific activities cannot, or only provide it at a very high cost (Sullivan et al., 2014).

Authors' contributions

CR and NG designed the study and performed the data collection. NG conducted the statistical analyses. NG and CR wrote the first draft of the paper. MW reviewed the paper.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethical approval

The study was granted permission by the ethics committee of Bielefeld University (2021-121 from May 21st, 2021).

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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