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Intonation practices in Scandinavian traditional music – Towards an alternative analytical framework through the concept of tolerance

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Abstract

Intonation practices in Scandinavian traditional music are characterized by great variability and scholars have faced considerable difficulties outlining the composition and logic of tonal systems. The present study approaches this question by evoking the concept of *tolerance*, which implies a context-dependent flexibility in the intonation of notes and intervals. The analysis highlights the contextual and processual nature of pitch production and perception. The contextual dimensions comprise of 1) discursive conditions that frame and inform how tonal relations are conceptualized, 2) the specific musical context for a tonal event, which includes the sequential placement of a note in a melodic-rhythmic pattern and the musical features that coexist with pitch/intonation in the musical moment (timing, attack, dynamics, intensity, timbre), and 3) the idiomatic characteristics of the instrument being used and the associated sensorimotor logic behind the production of a note or a sequence of notes. The processual dimension concerns how intonational norms and frameworks or reference structures are shaped through the musical activity itself, including the corresponding unfolding of musical events. In line with this practice-oriented approach, the analysis also broadens the concept of intonation to include all elements of performance action that contribute to the sonic shaping of a tonal event.

In Scandinavian traditional music, intonation practices are characterized by great variability, including an abundance of pitches and intervals that conform neither to the equal-tempered system nor to just intonation.[1] The phenomenon is often described using terms such as blue notes, quarter tones and microtonal pitches, and is a prominent feature of many traditional musics around the world (Chattopadhyay, 2022; Farraj and Abu Shumays, 2019; May, 1983; Rice, 1994; Schneider, 2001). With regard to Scandinavian traditional music, there is ample evidence to suggest that these intonations represent intentional and aesthetically meaningful musical behavior (Ahlbäck, 1986; Kvifte, 2012; Omholt, 2008; Rosenberg, 1996; Sevåg, 1993; Westman, 1998). At the same time, there is no general agreement on how to conceptualize the phenomenon. This concerns 1) the origin of traditional music's tonality, e.g. whether it is to be found in processes of cultural diffusion and indigenous adaptation or in nature-given conditions (such as the harmonic series); 2) the composition and logic of tonal systems: whether they are to be understood in terms of (alternative) scales, genre-specific modes, or as patterns conditioned by shifting contextual factors, including instruments and playing techniques; 3) the nature and degree of variability, including which notes that are flexible, under which conditions and to what extent; and 4) how tonal relations are envisaged to be conceptualized by traditional performers.

These quandaries also raise the more fundamental question of whether there is a system at all and whether it is possible to represent its logic by means of established musicological concepts. In this vein, Omholt (2015) questions whether an oral tradition, largely lacking written representations and theorizations, could be expected to harbor an abstract system of tonal relations. He also demonstrates that detailed measurements of intonations in Norwegian vocal and instrumental folk music show a degree of variability that is difficult to reconcile with any one explanatory model (Omholt, 2015, 2021b). In this context, he uses the term tolerance to indicate that whatever the explanations behind the observations, there apparently is freedom and flexibility in how musicians treat the pitch domain in perform-

1. These are a few examples of how microtonal pitches and intervals typically manifest in tunes and songs played on different traditional instruments: https://vimeo.com/1009084542

ance. This is reminiscent of the concept of *rhythmic tolerance*, which I developed to account for the performative and interpretive flexibility of rhythmic patterns in the repertoire in question (Johansson, 2010). In the present study, I take this further by systematically considering the explanatory potential of applying the theory of rhythmic tolerance as an analytical framework for understanding intonation behavior in Scandinavian traditional music. This effort represents a complement to previous research by elaborating the notion that intonational behavior may be musically coherent without conforming to a theoretical model of pitch relations.

It should be noted that the subject area pertaining to intonation practices in Scandinavian traditional music is immensely broad and diverse, including not only theoretical explanatory models but also the consideration of historical layers; regional, local and individual differences; and instrument specific constraints and affordances. It is not my ambition to cover this vast field of topics or to provide competing descriptive or normative accounts of tonal systems and relations. Instead, my aim is to offer an alternative conceptual lens to think about the seemingly inconsistent, yet musically coherent intonation practices found in traditional styles of playing and singing.

The article is organized as follows: First, I briefly explain the concept of rhythmic tolerance and outline how it may translate into the domain of tonality and intonation. Then follows an analysis of two musical examples through which I aim to assess the analytical application of the concept of tolerance in more concrete terms. Finally, I discuss the implications of the proposed conceptual framework for the analysis of tonal systems and associated intonation behaviors.

Implications and applications of the tolerance concept

The concept of rhythmic tolerance (Danielsen et al., 2023; Johansson, 2010) was initially developed to account for the striking rhythmic-temporal variability that characterizes certain styles of traditional Scandinavian fiddle music. The starting point is the following observations: 1) In the perform-

ance of traditional dance tunes, beat and measure durations may vary considerably across and within tunes seemingly without compromising the collective experience of flow, tempo, and groove. 2) The experienced location of rhythmic events (known as the "perceptual center" or P-center) may vary between subjects and contexts (Danielsen et al., 2022), again without negatively impacting musical interactions. 3) Co-occurring microrhythmic interpretations and behaviors may be experienced as coherent and synchronized despite substantial discrepancies in absolute terms. Correspondingly, the concept of rhythmic tolerance concerns three dimensions of rhythmic production and perception: 1) the flexibility of the rhythmic framework; 2) the tolerance with which rhythmic events are perceptually identified on a time axis; and 3) how rhythmic events are synchronized between performers. Finally, the extent to which the mentioned variabilities and discrepancies are noticed and actively engaged is contingent on a number of musical and contextual factors. For instance, there is evidence to suggest that substantial (when measured) variations in beat duration may go undetected by expert listeners and, accordingly, that such beat-timing variations are not in themselves a focus of attention (Johansson, 2022a). From this perspective, tolerance implies that beats are passively "allowed" to fluctuate rather than being intentionally shaped to particular durations. In other contexts, variabilities are consciously assessed but considered to be within the span of the musically acceptable.

None of this implies that rhythmic-temporal fluctuations are random or the result of a lack of performance precision or control. To illustrate, previous research has demonstrated that durational values are closely aligned with how melodic-rhythmic segments are shaped and performed, including very precise replications of timing patterns when motivic patterns are repeated in a performance. Additionally, duration (short/long) tends to be conflated with accentuation (light/heavy), both in how rhythmic aesthetics are described and in the sense that the intentional manipulation of the one (more or less unintentionally) affects the other (Johansson, 2010, 2017, 2022a). These examples indicate that the production, perception and aesthetic assessment of rhythmic/temporal patterns is dependent on how they coexist and interact with other musical elements. Tolerance, then,

should not be taken to imply that timings are allowed to be imprecise or to deviate from the reference, given that the mentioned durational patterns, while seemingly irregular, make perfect rhythmic sense as an integrated part of a musical whole. It is only when broken down into an isolated parameter assumed to constitute a system of its own that timing will appear inconsistent. Thus, the implication rather is that what constitutes a rhythmic reference at a given musical moment is contextually contingent. As will be further discussed below, I suggest that a similar line of reasoning can be applied to intonation practices and their outputs.

Directly translated to the domain of tonality and intonation, the concept of tolerance implies that there is a context-dependent flexibility in the intonation of notes and intervals as well as the framework against which it is produced and perceived, thus contradicting the notion of intonational fluctuations as deviations from a norm. Following the logic of the concept of rhythmic tolerance in more detail, the first dimension of intonational tolerance concerns the flexibility of the tonal framework, the implication being that intonations may vary considerably across and within tunes and performances without compromising one's experience of the performance being tonally coherent and in tune. In line with the above discussion of rhythmic tolerance, it may also be useful to expand this dimension to include variability and flexibility in what constitutes a tonal framework at a given musical moment. This implies that the frame of reference may change within one and the same performance, but also that several frameworks may be operational at once. In this context, variation between frameworks is not to be confused with key changes/modulations or similar. Instead, what is referred to are different *types* of frameworks. Such frameworks or reference structures may include scale structures, modes, tonal centers, melodic formulas or some other artifact of a tonal system, but also acoustic features and the motor logic of sound producing movements.

A second main dimension of intonational tolerance concerns the identification of tonal events along the pitch axis, that is, the perceptual ordering of notes from low/lower to high/higher. The references for identifying pitch may include melodic intervals and movements constituting the immediate context of the note, virtual intervals (the note's relation to the root or a

tonal center), or simultaneously sounding notes (harmonic intervals). Tolerance, then, implies 1) that one and the same intonation may be perceived differently by different listeners and/or under different contextual conditions, and 2) that a particular pitch may be perceptually extended to form a widened zone or region rather than being a defined point along the pitch axis.

Experienced pitch has been shown to be affected by intensity/loudness (Schneider, 2018), the use of vibrato (Brown, 1991), timbral features and tonal context (Warrier and Zatorre, 2002). Thus, it again needs to be acknowledged that musical parameters perceptually interact. Moreover, in Scandinavian fiddle music melodic onsets are often intentionally ambiguous by the use of slides, ornaments and double stops with asynchronous onsets (Johansson, 2022a; Danielsen et al., 2023). While these factors relate to why determining an exact pitch location is more and less difficult, the concept of tolerance concerns the perceptual (what is heard) and conceptual (how it is made sense of) conditions under which such a determination is performed. The second aspect of tolerance mentioned here – which concerns the perceptual extension of a pitch location – requires some additional explanation in this regard. The corresponding dimension of rhythmic tolerance is equivalent to Danielsen's (2023) concept of *beat bins* and implies that the start of beats is not experienced as specific points in time but rather as shapes with varying temporal extension. These beat bins may be narrow or wide depending on a number of factors. For instance, diffuse onsets, slow attack/rise time or multiple competing onsets occurring more or less simultaneously may contribute to a widened beat bin. Moreover, research has shown that genre-specific musical training and experience – including familiarity with particular sounds, instruments and sound-producing techniques – affect the perception of both the location (P-center) of a beat onset and its width (beat bin) (Danielsen et al., 2022).

Directly translated into the pitch domain, then, one might speak of intonational "pitch bins" of varying width depending on the composition and complexity of the sound. For instance, a sine tone would potentially have (or rather afford) a narrower perceptual bin than a compound sound with a complex overtone structure. The scientific literature on pitch per-

ception at least supports this idea indirectly by documenting that the pitch of complex tones is more ambiguous than that of pure or less complex tones (Fastl and Zwicker, 2007; Terhardt, 1974). However, ambiguity in the sense of being difficult to determine does not translate directly into *width*. More precisely, the concept of width in this context does not merely imply that several interpretative options are possible and viable but that the pitch "location" as such has a certain extension. It should also be noted that at this point, width is mainly referred to as an experiential quality and/or an interpretative category, and it remains for future research to explore how it can be determined in quantitative terms.

Finally, the third dimension of tolerance – which concerns synchronization behavior among musicians who play together – suggests that different co-occurring microtonal interpretations and behaviors may be experienced as coherent and/or synchronized despite discrepancies in absolute terms. Notably, some of the most acknowledged and influential Scandinavian traditional music ensembles use microtonal intonations frequently, which often results in "dissonant" relationships between melody voice and accompaniment.[2] Thus, given the hypothetical premise that the point of reference for assessing intonation behavior in ensemble playing is pure harmonic intervals, there clearly is tolerance in the sense that intonations are allowed to deviate considerably from the reference. The same could be said about the abundant microtonal pitches and fluctuations in intonation found in solo playing and singing: Given that these are assessed against a conventional reference, such as a scale or similar, there evidently has to be a tolerance for the deviant intonations to be musically acceptable. However, such a one-dimensional line of reasoning runs the risk of simplifying and reifying the generative and experiential dimensions of these intonation practices. Instead, I want to reiterate the previous point about the importance of context, which applies to both musical factors and the broader contextual conditions under which the "deviant" intonations occur, not least including

2. Groupa: https://open.spotify.com/artist/57YB3h6MfLqtp3w2aozGEB?si=ZabQaI3lQZ-jaEDLgWOoMA Per Gudmundson and Bengan Janson: https://open.spotify.com/album/4vFqXvbodXIJDgwZdIjah5?si=2bcmnhA0SpiZZysJpO2nUw Egeland/Edén/Marin: https://open.spotify.com/ album/7HZOWEwAdL7ijZjwZ4hLSw?si=6KezOPHpQwSP5irA3RTbWQ

the aesthetic standards of a particular style of playing or singing. To illustrate the latter point, there is something inherently inconsistent in the notion of microtonal intonations as deviations from a norm when such intonations actually are the norm. Moreover, a musical culture and its associated musical practices prime participants to perceive and make sense of musical details in certain ways (Danielsen et al., 2022), which includes pitch relations and their experiential status. Without considering these fundamental contextual factors it does not make sense to speak of degrees of tolerance for intonational fluctuations since there is no objective baseline against which these can be determined.

In more detail, as was the case for rhythmic tolerance it is hypothesized that the extent to which intonational variabilities are noticed and deemed musically significant is contingent on a number of musical and contextual factors. Again, this is also related to the condition that musical parameters interact and overlap, both in terms of how they are produced and how they are perceived. This implies the possibility that pitch variations may be an indirect side effect of other musical elements and performance actions, forming tonal patterns that emerge as coherent (as opposed to deviant) when the totality of co-occurring musical events is considered. Taking this further, what is measured to be a pitch variation (relative to some reference) is not necessarily intended or perceived as a variation in pitch.[3] Similarly, microtonal intonations and variations may be tightly embedded into the melodic-rhythmic flow of the performance to an extent that they are not heard as microtonal intonations or variations. This, in turn, may indicate that the framework within which intonations are manifesting comprises several musical elements – including melodic, rhythmic and sound-related features – in changing configurations. Again, then, the implication of the concept of intonational tolerance is not (merely) that intonations have an allowance for fluctuations in relation to a reference. Instead, what constitutes a tonal reference at a given musical moment is contextually contingent.

3. While not concerned with intonation per se, a recent interview-based study on groove-forming elements in Norwegian traditional fiddle music lends some support to this line of thinking. Several fiddlers noted the importance of intonation to rhythm and groove, suggesting that these are integrated rather than separate aspects of performance. Similarly with regard to sound, one fiddler noted: "All those microtonal embellishments…the notes in between…I'm about to stop calling this intonation. It's more a sound thing" (Johansson, 2022a, p. 60).

Analysis

In the following, two musical examples are examined to illustrate and assess the application of the concept of tolerance in the analysis of intonation patterns. The analysis is confined to music performed on solo fiddle, which means that the issue of synchronization between players/instruments is not considered at this point. Moreover, ideally several instruments, including singing, should be included in the analysis given that idiomatic features of different sound-producing technologies are assumed to affect how tonal features are produced and perceived (see further below). This said, the purpose at this stage is merely to outline the foundation for an analytical approach. When applying this approach to analyze specific manifestations of intonation behavior, then, factors such as the idiomatic characteristics of the instruments being used should be carefully considered, as should the full range of formative contextual factors as discussed in the final part of this article.

The examples are selected strategically to serve the purpose of the study, which is to explore the concept of intonational tolerance and its contextual variables. This does not mean that the chosen recordings are exceptional in any way – they are indeed representative in the sense that they exemplify a type of musical behavior (intonational variation in general) that is ubiquitous in Scandinavian traditional music – and a number of other recordings could have served the same purpose. This does not imply an assumption that other recordings would feature similar intonation patterns. It only implies the presence of variability, and the assumption that it could be assessed in terms of tolerance and its contextual contingencies. This said, to more fully explore and assess the analytical potential of the proposed approach, recordings that represent a breadth of different styles, traditions, instruments and performers should be engaged.

The pitch measurements (or more precisely estimations) are done using the audio editing tools Melodyne[4] and Audition[5]. Melodyne calculates the average pitch ("pitch center") of each played note. It also shows fluctuations

4. https://www.celemony.com/en/melodyne/what-is-melodyne

5. https://www.adobe.com/products/audition.html

in pitch within each note ("pitch curves"). Audition's "spectral pitch display" is used to double check intonations that are ambiguously represented in Melodyne. Audition is also used for spectral analysis of overtone distribution and other microlevel features of sound that are envisaged to interact and interfere with the experience of pitch.

The first example features a *springleik* (a traditional dance tune in triple meter) performed by the Norwegian fiddler Leif Inge Schjølberg.[6] The tune is played in A minor with a raised G on the D string (G#4) and a raised F on the E string (F#5). As is the case with most Scandinavian fiddle music, the tune is played in first position, and there is a consistent correspondence between finger position and note position (E4 is always played with the first finger on the D string, A5 is always played with the third finger on the E string etc.). This is an important context for understanding intonation behavior, as will be further discussed below.

All note positions are relatively stable in terms of intonation with the exception of the second finger on the A string, which corresponds to the C/C# or the minor/major third from the root. As shown in Figure 1, the intonation of this note varies significantly. While some of this variation could possibly be interpreted as an alteration between C and C#, most of the notes fall in between the minor and major third, thus corresponding to what is commonly referred to as quarter tones.

A key question for the present analysis is whether these seemingly erratic pitch fluctuations are patterned in some way. Accordingly, in Figure 2 the data is arranged so that each pitch value can be seen in relation to the melodic-rhythmic context where the note appears. Some patterns emerge: In Main motif 1 the first C is consistently high, followed by a low C. Then follows a gradual raising of the intonation throughout the phrase back to a high C that is slightly lower than the first one.[7] There is also variation within this pattern, particularly in motif 1a, where the last/fourth version features

6. The recording is featured on the album *Fele-ljom* (Schjølberg 2001). Audio: https://vimeo.com/882070341?share=copy#t=0

7. Ahlbäck (1986) and Westman (1998) use the term "krypintonation" (Swedish) for this phenomenon. Directly translated, "kryp" means crawling (as opposed to walking), indicating a movement in small steps.

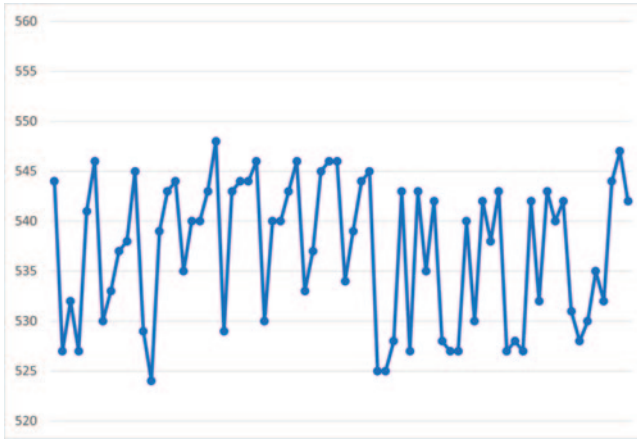


Figure 1. Springleik performed by Leif Inge Schjølberg.
Pitch in Hz for all successive occurrences of C5/the second finger on the A string.
A4 = 441 Hz.

a more consistent quarter tone intonation (there is no low C) and where the first version departs from the pattern of a gradual raising of the C.

In Main motif 2 there is a different pattern: The first three Cs are low, close to a just-tempered minor third, which contributes to giving the passage a minor feel, in contrast to the more ambiguous tonality of the performance overall. Then follows a variant of motif 1 (markers 4-8) with a correspondingly similar intonation pattern. But instead of a gradual raising of the C there is a high-low-high-medium-high pattern. Again, the exception is the last/fourth version, which leans more towards a quarter tone intonation and reverses the pattern in the last three notes. (Fig. 2)

Evidently, the variation in pitch follows certain patterns which are aligned with the melodic-rhythmic structure of the tune. In addition, there are variations within these patterns. These observations are in keeping with the notion that intonational patterns are contextually contingent beyond the key or mode in which a tune is played. More precisely, the most significant contextual factor that influences intonations seems to be the note's position within the melodic motif. From this perspective, one might speak

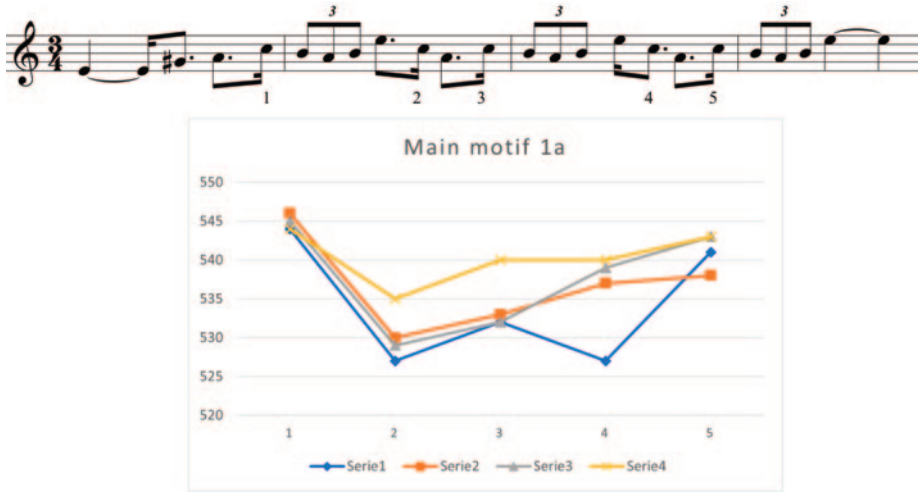
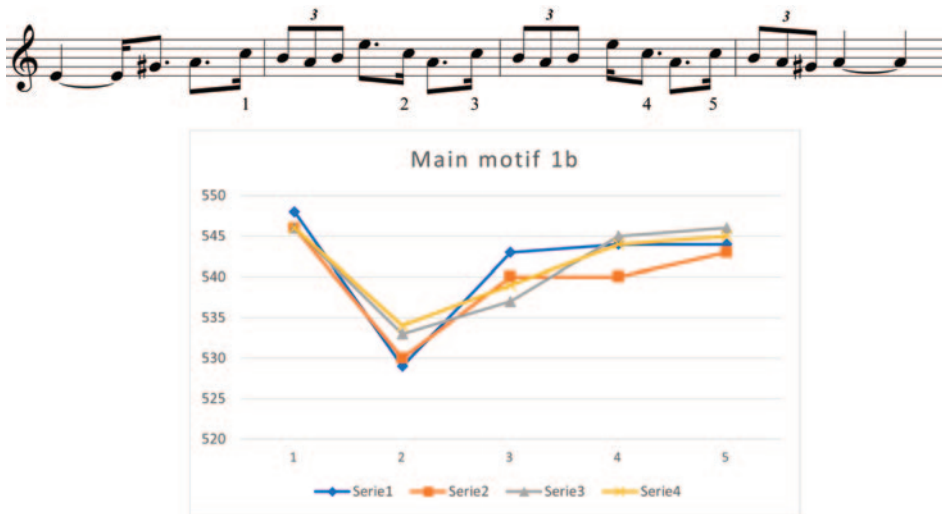
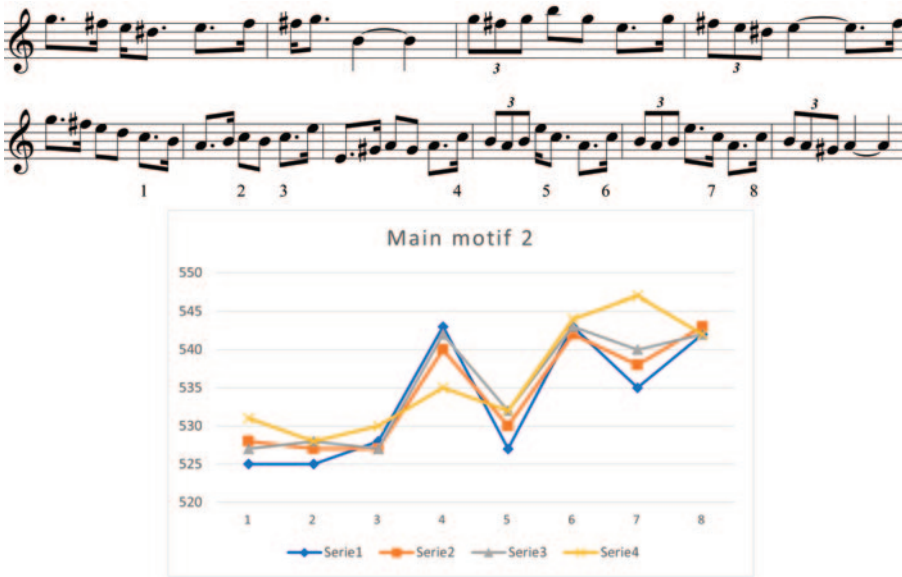


Figure 2. Springleik performed by Leif Inge Schjølberg. Pitch values for all Cs in their respective contexts. The tune is repeated once in its entirety (AABB AABB), meaning that each motif is played four times (serie 1 - serie 4). Note that these are skeleton transcriptions. The actual performance is heavily infused with ornamentations, double stops and phrasings/bowing patterns in a variety of configurations.





of variation along two dimensions: one in relation to the root (a low C, a high C, a quarter tone C etc.) and one where variation is defined in relation to the motif as a reference. The latter is shown in Figure 2 as discrepancies between the four lines representing the different versions of each motif. According to this logic, a pattern is formed through the performance itself and the term variation is reserved for the different ways in which the pattern is realized, including that certain notes within the pattern (again as opposed to a scale) are more stable while others are more variable. In other words, when established the pattern references itself and the difference in pitch from one C to the next is to be considered a characteristic of the pattern rather than a variation.[8] The fact that the patterns and variations observed in Figure 2 are difficult to pick up in their actual context further reinforces this point. To paraphrase one of the predictions from rhythmic tolerance, it could be argued that the various intonations are so seamlessly embedded

8. Westman (1998, p. 132) argues that the span of variability within a given pitch category (D/F/G, third/fourth/sixth etc.) in traditional fiddling actually is much smaller than what appears to be the case if the placement of the note within melodic formulas (rather than merely its relation to the root) is considered.

into the overall melodic-rhythmic-dynamic flow or logic of the performance that they remain largely undetectable *as* variations in intonation. They may be clearly noticed if taken out, and they may contribute to a more general sense of continuous variation, but not necessarily in the sense that intonation stands out in the performance.

While it may be convincingly argued that the melodic motif is a strong influential factor and context for explaining individual intonations, it is not insignificant that the note in question happens to be the third and that its intonation is controlled by the second finger. Various creative uses of the second finger in an "A minor" setting are ubiquitous across fiddle tunes and performances, suggesting that it might also be relevant to consider the "C"/second finger as a category in its own right, albeit with melodic context in mind. This, in turn, would indicate some configuration between categorical and within-category variations. While not implying anything about the performer's intentions, a case could possibly be made for each of the following alternatives:

- Two categories – low and high. While this alternative could be supported by the evident alteration between a lower and a higher intonation, it implies that pitch precision and resolution is low compared to the precise and nuanced treatment of pitch in the performance.
- Two categories – low and middle. Considering that there is no C# in terms of absolute pitch values, it could also be argued that the two categories should be C/low and various gradations of the quarter tone. This alternative implies that there is a perceived virtual pitch position (C#/high) that is not utilized, and is thus contingent on a higher degree of context-independent pitch perception than the previous alternative.
- Three categories – low, high and middle. In this alternative, the low and high pitches could be seen as perceptual anchor points, while the remaining pitches represent a wider and more flexible in-between category.
- Four categories – low, high and two middle. Again, the low and high intonations could be seen as perceptual anchor points, but the remaining intonations are split into two categories to reflect the semi-systematic alteration between different intonations of the quarter tone.

– Five categories. This implies a very high pitch resolution, not least considering that the various possible intonations of "C#" are not utilized. This said, there may actually be support for this alternative when closely scrutinizing the pitch values in Figure 2. For instance, in 7 out of 8 versions of Main motif 1 the intonations follow a pattern with five distinguishable steps. Notably, however, the pattern is not consistent across versions in terms of absolute pitch values. For instance, the fourth C in version 3 is higher than the fifth C of version 2.

A general point that can be drawn here is that how pitch is treated in a particular performance shapes the reference structure against which intonations are assessed. An important context for this argument is that there is no agreed-upon microtonal scale that exists independently of different tunes, performances and the intonational behavior of different traditional performers. At the same time, what is actually performed in the individual case needs some kind of reference to make musical sense. According to the present argument, this is achieved through pattern formations, repetitions and variations within the performance itself. To illustrate in a simplified way, if there is only one intonation of C5 there is no need for three, four or five categories. Similarly, intonations that for whatever reason appear to fluctuate randomly do not imply more categories (except for the category "out of tune"), while consistently patterned intonations potentially do. In this way, the two perspectives discussed above – intonations as aligned with the melodic motif, and the "C" as a category in its own right – are connected in the sense that the former helps to establish that intonations are patterned rather than random, which in turn supports the activation of additional micro-categories to account for the precise and musically logical treatment of pitch in the performance. Here it needs to be pointed out that the fact that intonations are aligned with melodic motifs in a particular way in one particular performance does not imply that the observed pattern is normative, as it could equally well have been different in the context of another performance. In other words, it is not implied that intonations are matched to the motif – as if it required a particular pitch pattern that the performer attempts to replicate – but rather that the alignment between

melodic context and intonations is performatively established through the performance itself, implying that that intonations emerge as intrinsic to the motif after the fact so to speak. Tolerance, then, is a necessary condition for this form of retrospectively established normativity to arise.

The contextual and processual nature of pitch production, perception and categorical determination suggested here can be further highlighted by considering last point/alternative above, including the overlap and "inconsistency" between the five pitch categories. Firstly, according to the present argument the five categories are not contingent on an underlying microtonal scale beyond the (whether intuitive or reflective) conception that the "C"/second finger in certain tonal modes (A or D "minor" modes) is malleable. It is first when this flexibility is utilized in a particular way, then, that one might speak of a certain number of micro-categories (or, depending on perspective, a fewer number of categories with within-category expressive shadings). Secondly, the five categories are not contingent on an exact matching between the different versions of the motif. Concretely, the gradual raising of the "C"/second finger may well be performed and perceived as a consistent four-step movement regardless of absolute pitch values, i.e. without having to remember the individual pitches of previous versions.

With regard to tolerance, the above discussed observations and interpretative alternatives present an intriguing and challenging case. On the one hand, the example illustrates the flexibility of the tonal framework. Apparently, a range of intonational options are available. On the other hand, as previously indicated it needs to be added that there is a significant difference between the premise that pitches are allowed to fluctuate (in the sense of being imprecise and/or irregular), and the premise that there need to be flexibility to allow for precision and nuancing. This pertains to the notion that the first dimension of intonational tolerance also includes "variability and flexibility in what constitutes a tonal framework at a given musical moment" (see "Implications and applications of the tolerance concept"). For instance, when melodic context was taken into account there was a high degree of intonational consistency in the springleik. More precisely, when using the note's placement within the melodic motif as a reference the pitch fluctuation (cf.

the need for a tolerance) is limited to the instances where there are pitch discrepancies between the different versions of the motif. The analysis also illustrates how the amount and tolerance range of pitch categories are contextually variable and dependent on the precision and consistency of the performer.

One problem with the above proposed logic is that the observed motif-aligned intonation pattern is not some commonly shared norm as much as it is a product of the performative behavior of this particular fiddler in this particular performance. This inevitably takes us back to a more general notion of tolerance understood in terms of a freedom to shape intonations in accordance with individual skills and preferences. Without this premise, the process that in turn shapes a reference structure for the finer nuances and tolerances at a lower level could not occur.

Interaction, interconnection and overlap between musical parameters

The second example used in this study is another tune from the same album by Leif Inge Schjølberg.[9] This is again a springleik, but it is played very slowly as a listening piece. The example is meant to illustrate how performed and perceived intonations are affected by and interconnected with other expressive elements or musical parameters. The analysis mainly pertains to the second dimension of intonational tolerance – the identification of individual tonal events along the pitch axis – but it is also relevant to consider in relation to the flexibility of the tonal framework (the first dimension).

Figure 3 represents two versions of a two-measure phrase, the first occurring at the very start of the performance and the second when the tune is repeated at 01:32 minutes into the recording. The two versions are identical as far as what can be shown in standard notation, but there are a number of differences on a microlevel, including pitch. Without assigning prominence to my own interpretation, I find that the second beat (the F marked with arrows in Figure 3) in the second version sounds notably higher in pitch than that of the first version. However, measurements in-

9. Audio: https://vimeo.com/882064524?share=copy#t=0

dicate a difference in average pitch of as little as 1,5 Hz (7 cents in this context) between the two versions. Compared to the pitch fluctuations observed in the first example (cf. Figure 1), this value is extremely small. How, then, can it be argued that this is a musically meaningful difference?

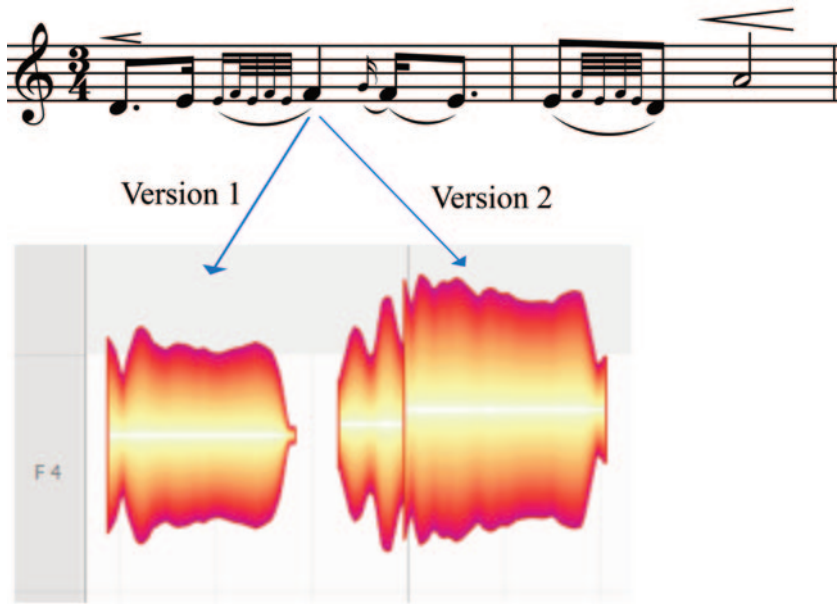


Figure 3. "Melovitt etter Slettmoa," springleik performed by Leif Inge Schjølberg. Two versions of the opening two-measure phrase from the same recording of the tune. The "pitch blobs" are from Melodyne and show the calculated average pitch of the note (F) from which the arrows are pointing for version 1 (left) and version 2 (right). Audio samples: https://vimeo.com/918294740?share=copy 2a: The two versions of the analyzed two-measure phrase. 2b: The two versions of the F without context. 2c: The same as 2b but resampled to half speed.

In approaching this question, I first want to reiterate that measurements alone cannot determine whether a difference in pitch is perceptually and musically significant. In addition, a range of contextual conditions need to be considered. This includes the distance between the compared notes in

the sense of whether they are presented in immediate succession or separated by silence and/or intervals of musical content (Cuddy and Dobbins, 1988), and the degree of similarity between the compared musical segments (Warrier and Zatorre, 2002). Taking this further, it could be argued that context also includes the totality of musical parameters and sound features within which pitch emerges. The two versions in Figure 3 clearly are different, which prompts the question how the different features interact to produce this overall musical effect, but also whether other elements of the note's composition contribute to the sensation of a raised pitch. To address these questions more systematically, I have identified a series of microlevel elements that differ between the two versions of the second beat, some of which may possibly interact and interfere with the experience of pitch:

– Version 2 is higher in intensity, both in terms of volume and a broader spectrum of overtones being activated.
– The dynamic contrast is larger in version 2.
– In version 2, the onset of the second finger is more pronounced and distinct (in version 1, the transition from the E to the F is almost inaudible), and the ornamental movement is more pronounced and distinct.
– The microrhythmic architecture of the ornament is different with version 2 being more asymmetrical (the temporal proportions between the notes are 37-59-68-38 ms in version 1 and 38-58-75-30 ms in version 2).
– The "vibrato" (which is clearly not a conventional violin vibrato) that rounds off the note is more pronounced and distinct in version 2 (in version 1, the pitch oscillation is barely audible).
– Version 1 is relatively static pitch-wise, while version 2 moves from a low intonation to a higher intonation within the ornament. This is visible in Figure 3: the software has chosen to split the F into two notes.

The scientific literature on pitch perception referred to throughout this article supports the idea that some of these features – particularly differences in intensity and dynamic contrast – may make the difference in pitch between the two version appear larger than it actually is when measured. In addition, the shift from a lower to a higher intonation in version 2 (cf. the

last point above) contributes to a sense of movement or development that influence the experience of the intonational properties of the phrase. It could also be speculated that the ornamentation, "vibrato" and other dynamic elements contribute to a perceptual extension of the pitch location in the sense that it forms "a widened zone or region rather than being a defined point along the pitch axis" (see "Implications and applications of the tolerance concept").

With regard to how tolerance comes into play in this scenario, it may be speculated that the configuration of sonic elements affects 1) when and how intonational fluctuations are detectable, 2) the precision with which particular pitches are identified, 3) the aesthetic function of fluctuations in and configurations of intonations, and 4) whether they are within an acceptable range. This said, as was the case with the first example (Figure 2), there are some caveats to take into account for these propositions to be conceptually consistent, particularly with regard to isolating pitch from the other parameters. Above all, it should be noted that the listed microlevel elements have been identified by means of close analytical scrutiny aided by software tools and repeated listening at reduced playback speeds. I am not suggesting that these details are intentionally and consciously manipulated by the performer, or that they are likely to be picked up or attended to as isolated features during normal listening. The event seems better described as a multidimensional whole of musical content in which pitch is but one of many dynamically interacting elements. From this perspective, musical parameters are not categorically separated but rather converge in contextually dependent ways, implying that there is not necessarily any clear distinction between structural and ornamental, dynamics and timing, intonation and sound coloring etc. One feature that further illustrates this overlap between expressive parameters and performance actions is the smooth and seamless transition from the ornamental movement to the vibrato movement (note also the similar oscillation frequency). Rather than appearing as separate elements that are added sequentially, these stand out as *one* integrated action/movement/musical effect.[10] Similarly, from a performance perspective it might be reductive to separate the pitch properties

10. This is most readily heard in the slowed down version (Audio sample 2c).

of the event from the remaining features that together constitute the overall effect.

This line of thinking is supported by the idea that sound images and their conception are tightly interconnected with the body actions by which they are generated, not merely in the sense that particular actions inevitable are taken to produce a particular musical effect, but in the sense that the action *is* the effect. Bowing is a very illustrative example of this by being one of few "musicological" concepts that is actually used by traditional fiddlers and by decidedly referring to a concrete action/body movement (moving the right arm in certain ways), but implicitly also to the musical effects that different bowings produce. These effects go beyond how many notes that are tied together (including the distribution of dynamic accents, subdivision ratios and rhythmic grouping), suggesting that the concept of bowing is a stand-in for what in reality is a range of different musical features and combinations thereof that remain implicit to the overall concept and associated action. In the present case (Figure 3), there are two different action bundles producing two different compound sound images, which may be abstracted into several parameter values (pitch, duration, intensity distribution, dynamic envelope, timbre) for analytical purposes. From a practical-musical perspective, however, such a deconstructed sound image may be more or less arbitrary to what the performer perceives to be doing. Similarly, the matter at hand is not necessarily one of causation in the sense of pitch being affected by other musical elements. Instead, the various elements may be seen as intrinsic to one and the same action object.

One potentially fruitful perspective that may capture some of this multidimensionality and associated interactions between expressive parameters is to broaden the concept of intonation to include all elements of performance action that contribute to the sonic shaping of a tonal event. When it comes to the sound produced, this would include, but not be limited to, pitch. Consequently, from this perspective tolerance is perhaps best described in terms of a general openness to various technical approaches and associated musical solutions (note that a similar conclusion was drawn in the analysis of the first example). Arguably, this openness also includes an aesthetically meaningful ambiguity as to which expressive parameters are

being activated and how, which in turn is reinforced by a general absence of descriptive and prescriptive theories and vocabularies.

Discussion

The concept of rhythmic tolerance was developed in response to scholarly research and debates that searched for rules and principles that could explain and predict rhythmic patterns in typical dance tunes (particularly the Norwegian pols/springar and the equivalent Swedish polska). Basically, the genealogy of this research started with a search for general principles. A striking example is the specification of a particular durational ratio between the three beats in certain asymmetrical *springar* styles.[11] A second stage could be identified in terms of a response to the observation that the mentioned timing patterns are not consistent in performance. Accordingly, rules were proposed that allegedly accounted for variability in a consistent way, including the proposition that beat duration fluctuations are compensated for by a prolongation of one beat being accompanied by a shortening of a neighboring beat so that the total measure duration remains constant (Blom, 1981; Kvifte, 1999). Even these predictions turned out to be difficult to reconcile with the realities of rhythmic performance (Johansson, 2010, 2017). Tolerance, then, could be seen as an acknowledgment that humans are unable to reproduce rhythmic patterns with the precision and control that the model prescribes; that there necessarily needs to be a flexibility allowing for imperfections. The problem with this line of reasoning is the more or less explicit presumptions that there exists an ideal model for rhythmic performance, that this model can be expressed in purely temporal terms (i.e. as particular durational ratios), that performers are guided and assessed by the model's predictions, and that discrepancies between the ideal model and performed rhythmic patterns are to be understood as either intentional expressive gestures or as more or less acceptable imperfections.

11. For example, Blom (1993, p. 177–78) specifies a 39:33:28 % ratio between the three beats in the so-called Tele-springar style.

Notably, the theory of rhythmic tolerance is not built on these premises. Instead, it rests on a processual and trans-parametric approach to rhythm, one implication of which is that rhythmic variability is intrinsic to the conception and performance of tunes and songs. From this perspective, there is no ideal or prescriptive rhythmic model against which performed rhythms can be assessed (whether as expressive or unintentional deviations). Rather, the model as such comprises multiple possible realizations. A related premise is contextual contingency across musical parameters, which includes how a particular rhythmic/temporal "variation" is aligned with the particular melodic-rhythmic-dynamic composition of a phrase/microphrase (Johansson, 2010, 2017, 2022a). The implication is, simply put, that a "deviant" temporal pattern may fit seamlessly within one melodic-rhythmic-dynamic context while the same pattern would appear discrepant in another context, even if it happened to match the generalized template used in descriptions of the rhythmic style in question. From this follows that time/timing cannot be understood with reference to its own constraints and that rhythmic tolerance as an analytical concept demands a consideration of a range of formative and contextual factors.

The above points mirror both how tonality and intonation have been treated in academic studies, and how the concept of tolerance might apply as a complement to existing theory in this field. To sum up the former, previous research has been characterized by a search for general rules and principles that could explain and predict intonation patterns, and that presumably function as a normative reference that guides performers (Omholt, 2015, p. 2). It is also largely presumed that the pitch/intonation parameter can be explained with reference to its own constraints, i.e. without taking specific contextual factors into account.[12] Finally, given the actual

12. There are notable exceptions to this. Westman (1998) largely rejects scale-based explanations and presents a model in which pitches are seen as affected by timbre/resonance, melodic context and individual expressive choices ("intonation"). Omholt (2021a) presents an analysis where intonation patterns in Norwegian fiddle tunes are shown to correlate with fingering patterns that are anatomically advantageous. Intriguingly, Jonzon (2025) makes a similar argument with regard to vocal traditional music. None of these explanations are compatible with the view that pitch relations constitute an autonomous system governed by abstract rules (i.e. principles that are independent of the particular *practices* through which they are manifested).

variability of intonations, models based on autonomous tonal systems require that there is a tolerance allowing for imperfections and/or expressive deviations from its normative predictions.

As I have argued throughout this article, the above view of tolerance represents a simplification and misrepresentation of the matter at hand. Instead, what I want to suggest is that intonational tolerance only makes sense as an analytical concept to the extent that a wide range of influential contextual factors are taken into account. These include:

1) The genre's normative discourse that negotiates its position and identity within a wider landscape of musical practices. Strikingly, the role and importance of microtonal intonations are very prominent parts of the contemporary academic and popular discourse on Scandinavian traditional music. Simply put, such musical behavior is not only expected to occur (albeit not by default) but is highly valued and part of what defines and distinguishes the genre (Kvifte, 2012). Given these conditions, it could be argued that there are situations where microtonal intonations are supposed to stand out and be noticed by virtue of being markers of musical mastery and stylistic authenticity (Kvifte, 2012, p. 109). This said, the issue here is not to predict the relation between discourse and practice but merely to underscore its importance to how tonal relations are conceptualized and assessed.

A related aspect of discourse that warrants attention is how and the extent to which intonation practices are accompanied by theories, abstractions and prescriptive terminology. Historically, there is little to indicate that traditional performers shared an explicit theory from which their intonational behavior could be derived. The immense intellectual effort by scholars and folk music collectors to make sense of traditional music's tonality (see Omholt, 2008; Sevåg, 1993; Westman, 1998) can be understood in light of this absence of explanatory discourse among the performers. Today the situation is different, with many traditional musicians entering higher music education programs where students are presented with an elaborate terminology, as well as exercises aimed to develop awareness and control over microtonal intonations (see Misgeld, 2014 for an illustrative example).

Again, it seems reasonable to assume that this will shape how tonal relations are perceived and conceptualized even if no detailed predictions are made.

2) Stylistic constraints and affordances: the (possibly implicit) aesthetic standards that characterize a particular style of playing or singing. On this level, tolerance could be thought of in terms of the nature and amount of intonational variation that can be afforded without disturbing stylistic coherency. As much as this appears to be a limitation on musical behavior, it is perhaps better described as the set of expressive potentials and interpretive resources that are available to musicians. Moreover, rather than being explicitly agreed-upon rules and principles, stylistic constraints and affordances are to be seen as largely intrinsic to the general practical knowledge that musicians accumulate through performing, listening, and interacting with other musicians and participants (Berkowitz, 2010, p. 2; Meyer, 1989, p. 10). Finally, these more or less implicit principles not only pertain to whether certain intonations are "allowed" within the style but also to whether and how they are perceived and assigned meaning. To clarify, through engagement in musical practices participants become primed to perceive and conceptualize tonal relations in certain ways. For instance, if microtonal intonations are ever-present – which arguably was the case for some older Scandinavian traditions – they might also be normalized to an extent that they possibly go unnoticed as a particular isolated aspect or feature of the music (note the opposite reasoning above). Similarly, to modern ears accustomed to digitally tuned music it might seem virtually impossible not to notice intonations that fluctuate and/or deviate from established norms.[13]

Another example that illustrates the relevance of considering stylistic constraints and affordances is the intrinsic openness ("tolerance") to individual and idiosyncratic approaches to music-making that characterizes

13. Aesthetic standards and tolerances related to intonation are likely also affected by situational conditions, some of which are: the setting where a performance takes place (concert, competition, dance party, informal social gathering); the physical space where the music is performed, including acoustic properties; how the music is mediated (direct/live or through a recording); and listening setting (e.g. casual listening in a social setting vs. individual analytical close listening).

many traditional musics, including how tunes and songs are interpreted, and various aspects of performance style and technique (Johansson, 2015, 2022b). The freedom of expression also extends to intonation behavior, implying that there is no particular set standard that could be expected to apply across performers or performances.[14] This also suggests that the norm or reference against which the intonational properties of a performance are deemed to be good, interesting, acceptable (or not) etc. is constantly negotiated through the very musical practices that it enables and constrains. This does not imply that anything goes from the outset. It does, however, imply that there is a significant element of "coming into being as it happens" when it comes to intonational aesthetics. That is, the more general openness to different technical and musical solutions implies that particular intonational behaviors are partly only retrospectively assessed. The concept of intonational tolerance in traditional fiddling does not make sense without these conditions. Clearly, existing and accepted intonations cannot be aggregated together to represent a tolerance range for intonations. Rather, tolerance is situationally determined, including who the performer is, the performance history of the tune in question, and specific musical contextual factors that determine whether particular intonations work as integrated parts of a larger musical whole (see further below).

3) The particular configuration of musical elements within which the intonations in question are located. Clearly, intonational tolerance is affected by musical context, both in terms of the threshold for noticeable differences and whether pitches are within an acceptable range. In this vein, Kvifte (2012, p. 99) notes that the tolerance for intonational variation will be much greater in monophonic vocal music than in fiddle music where two or more notes sound simultaneously. Westman (1998, p. 112) and Omholt (2015, p. 23) makes similar statements. Moreover, as was highlighted in my first example (Figure 2), the tolerance for intonational "variation" (this is only to be considered variation under certain conditions) may increase

14. There are definitely examples of performers attempting to mimic the intonations of other players down to the finest detail, particularly in educational contexts. However, this observation does not compromise the notion that individuality in interpretation and style is a fundamental feature of traditional musicking.

when intonations are logically patterned in relation to melodic context. Finally, I have argued that musical context also could be understood in terms of the totality of sound features within which pitch emerges, which in turn relates to the premise that musical parameters are interconnected, interdependent and overlapping. In sum, the analysis shows that particular configurations of musical elements may mask or highlight the intonational properties of a segment. This pertains to whether intonational variations are detectable, but also whether they are to be considered variations at all, and if so, whether pitch/intonation necessarily is the expressive parameter being activated. These considerations led me to propose an expansion of the concept of intonation to refer to the overall shaping of a tonal event without specifying if or how the performance action and its output should be separated into different parameters. This blurring or fusion of otherwise separate domains may be problematic from the point of view of music theory and comparative analysis, but I argue that the resulting ambiguity better reflects the musical realities of traditional fiddling.

The overall variability and undeterminedness of musical outputs are a significant context for understanding intonational tolerance, and this extends to all aspects of musical production and perception. There are many instances where it simply cannot be determined to which category a musical event belongs, including note onsets and timings (on or off the beat), rhythmic groupings (which notes that belong to which beat), subdivision (even or uneven), distinctions between structural and ornamental events etc. In some contexts, such ambiguity clearly is intentional on part of the performer and considered an essential part of the aesthetics of performance (Johansson, 2022a). When it comes to the pitch domain more specifically, Westman (1998, p. 130–31) makes an illustrative comparison between Western art music and traditional Scandinavian fiddle playing. In the former, intonations serve the function of communicating a distinction between pitch categories. For instance, there should be no doubt whether a note represents a minor or major third, which tends to be reflected in intonations that are polarized towards the outer limits of the spectrum. In contrast to this scenario, pitch categories in traditional fiddling are inherently ambivalent by potentially serving multiple contextually determined

functions (the note's position in a scale, melodic formula, polyphonic context and/or fingering pattern, and/or its sonic/timbral attributes). Again, this complicates the notion of tolerance in that the reference against which to assess the alleged flexibility is shifting. Alternatively, it highlights the point that what is flexible is the intonational framework as much as the intonations themselves. Moreover, while Westman uses the term ambivalent, it could be added that intonations also may be ambiguous in the sense that the very pitch of the note is unclear due to its spectral components or overall sonic properties (cf. Figure 3 and the associated analysis).[15] This pertains to the second dimension of tolerance, including the notion that the pitch of a note may be perceptually extended to form a widened zone or region rather than being a defined point along the pitch axis.

4) Performance constraints and affordances: the idiomatically constrained handling of particular instruments. Notably, there are absolute constraints as in piano players simply cannot synchronize to microtonal intonations, and no one would expect them to. But this goes much further than that: idiomatic constraints and affordances are not simply determined by technological limitations but are rather shaped through the stylistically framed interactive engagement with particular instruments (Johansson, 2015; Kvifte, 1989; Røine, 2024; Theberge, 1997).

One example is how fiddle players have developed intonation practices where certain finger positions and combinations thereof are favored over others.[16] Having analyzed 500 transcribed Norwegian fiddle tunes, Omholt (2021a) observes that certain finger positionings occur far less frequently than others representing the same note in a different octave. This includes many instances where the intonation of "the same" note on different strings is not consistent in cases where the melody spans two or more octaves.

15. On this note, a central element of Westman's (1998) thesis is the observation that notes with relatively little resonance (on the fiddle) are more variable in pitch than notes with strong resonance, which in turn could be interpreted in line with the premise that the former are more perceptually flexible and ambiguous in terms of pitch.

16. This is also reflected in how traditional fiddlers talk about "notes," where descriptions such as "the second finger" often seem to be preferred over "the C#," "the fifth" etc. (Johansson, 2022a).

These observations are very difficult to reconcile with an abstract system of tonal relations (a scale or similar) from which individual pitches are supposed to be derived. On the other hand, such non-octave-equivalent intonations often do make sense from the point of view of traditional playing technique, both in terms of idiomatic constraints (how it feels physically natural to position the fingers) and in the sense that the various intonations are part of characteristic melodic (i.e. fingering) formulas that are ubiquitous across tunes and performances but that do not translate well to other octaves (Johansson, 2022b; Omholt, 2021a; Westman, 1998). Similarly, in a study of improvisation in Irish traditional fiddle playing, I observed a number of instances of "alternative 'harmonisation' by means of double stops that do not seem to fit the harmonic context of the passage" as well as "notes that do not belong to the tonal mode of a passage" (Johansson, 2022b, p. 10). Here I argued that while these behaviors may be difficult to rationalize from a (any) music theory standpoint, "playing these notes arguably makes sense within their particular contexts, as parts of characteristic fingering formulas." A crucial premise of this argument, then, is that "context does not merely refer to the tonal-rhythmic structure of a passage but to the sensorimotor logic of interrelated sound-producing movements." Both Omholt and I also make the argument that these practically conceptualized behaviors are formative of the aesthetic reference, as opposed to being mere acceptable deviations from an expected norm.

Conclusion

What could the concept of tolerance achieve in this context beyond being a different way of saying that intonations are flexible and variable? If nothing else, my analysis and discussion have highlighted the contextual and processual nature of pitch production and perception, including the reference against which flexibility and variability can be identified and assessed in terms of tolerance. The contextual dimensions comprise of 1) discursive and situational conditions that frame and inform how tonal relations are conceptualized, 2) the specific musical context for a tonal event, which in-

cludes the sequential placement of a note in a melodic-rhythmic pattern and the musical features that coexist with pitch/intonation in the musical moment (timing, attack, dynamics, intensity, timbre), and 3) the idiomatic characteristics of the instrument being used and the associated sensorimotor logic behind the production of a note or a sequence of notes.

The processual dimension concerns how intonational norms and frameworks or reference structures are shaped through the musical activity itself, including the corresponding unfolding of musical events. Overarchingly, this can be thought of in terms of the ongoing interactive engagement with tunes and songs, instruments, playing techniques and interpretations, and how these practices are formative as much as reflective of intonational norms and constraints. On a more specific level, a processual perspective implies that intonational references are partly established through pattern formations, repetitions and variations within the individual performance where the references are to apply.

The processual and the contextual dimensions converge in the sense that both could be understood in terms of the other: the processual factors are also contextual factors and vice versa. What the processual perspective provides in addition, however, is a reminder that the various factors and their significance are not fixed once and for all. Without this premise, the present analysis and discussion could give the impression that any pattern of intonations can be neatly explained by some intricate multicontextual model. However, according to the present argument, intonational references and associated forms and degrees of tolerance are not only shifting between contexts but also emergent and evolving through the expressive behavior of performers and audiences. An important addition to this is that it obviously cannot be presumed that intonations conform to some (flexible) norm more or less by default. Not only do some performances fail to meet aesthetic standards, but it also should not be forgotten that intonation may not be such a big deal in some situations. The performers' and other participants' focus may be elsewhere, such as when playing for dancing and the importance of rhythm, groove and flow far exceeds that of microtonal precision. This is also a reminder that the more superficial notion of tolerance as an allowance for imperfections in intonation should not be ignored. This said, according to

the arguments made in the present article, this is not an either-or scenario: neither a complex system model nor one relying on random or accidental fluctuations will do justice to the observed intonational behaviors.

Whatever perspective is taken in these matters, it speaks against the notion of some generalized abstract system of tonal relations from which actual intonations supposedly are derived. Instead, the core of the phenomenon under investigation seems to be found in the qualities, behaviors and attributes that characterize an oral musical practice that is (or at least was) not accompanied by theoretical explications of its underlying determinants. In the absence of coherent and consistent systems, there inevitably will be variabilities and ambiguities, not in the sense that anything goes but in the sense that compliance with aesthetic standards is not contingent on rule-like principles against which the behavior of individual parameters (pitch/intonation, rhythm/timing) is judged. Here one could consider the vast variability of technical and musical solutions, versions of tunes, and rhythmical and intonational interpretations found in archive recordings, including those that represent the same tradition/style. In short, there is no obvious coherence to be found within any particular parameter but rather in an overall sense of well-formedness where the different performances conform to generalized criteria such as rhythmic flow (the music being danceable), overall melodic consistency (the tune being recognizable despite variations) and idiomatic constraints (musical solutions being "logical" from the point of view of how they are produced on the instrument). Arguably, no conventional music theory could possibly accommodate these dynamic and elusive mechanisms. Instead, I argue that what is called for is a comprehensive consideration of the full range of formative and contextual factors with a focus on the *practices* within which musical knowledge is embedded.

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