Neuroscience of Emotional Perception in Gurmat Sangeet:

How Shudh and Vakrit Notes in Raags Create Individual Experiences

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Abstract:

This paper examines the relationship between neuroscience and Gurmat Sangeet, with a specific focus on how *shudh* (pure) and *vakrit* (altered) notes in raags contribute to individual emotional experiences. By introducing Gurmat Sangeet raags and the significance of their unique melodic structures, this study aims to understand psychological and neurological mechanisms that shape how the listeners emotionally and neurologically respond to music. The analysis is divided into three sections: (1) an overview of Gurmat Sangeet and emotional and cognitive significance; (2) an explanation of *shudh* and *vakrit* surs and their functions; and (3) an investigation of how the musical elements contribute to emotional perceptions at an individual level.

This topic was chosen due to limited availability of interdisciplinary research combining Sikh musical traditions and neuroscience. By examining how the brain processes the two types of surs and produces its emotional responses, the paper seeks to deepen our understanding of Gurmat Sangeet through spiritual and a scientific lens.

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1. Introduction:

In the tradition of classical music, raags have not only been seen as musical scales, but rather as a means to evoke emotional and spiritual states capable of conveying distinct moods [1]. In Gurmat Sangeet, the Sikh devotional music tradition, raags are used to serve a deeper purpose of supporting spiritual reflection and connecting with the creator by amplifying the message of the bani. Each raag is shaped of certain notes “surs”, which may be either *shudh* (pure) or *vakrit* (altered/modified) [2]. The notes in each raag were chosen intentionally to guide the listener into each composition to get a certain emotional experience and spiritual connection that align with the teachings written in the holy scriptures of the Guru Granth Sahib Ji by the Guru [3].

This paper explores how these *shudh* and *vakrit* notes influence emotional and cognitive perception. Contrary to the spiritual role of Gurmat Sangeet that has been widely explored within Sikh devotional practices, its effect on the human brain remains under researched. By focusing

on the developments in cognitive neuroscience, this study examines how the structure of Gurmat Sangeet -specifically focusing on the surs- shapes a listeners' emotional response and psychological state.

The central question guiding this inquiry is: How do *shudh* and *vakrit* notes in Gurmat Sangeet raags shape individual emotional experiences and perceptions? Through analyzing raags, reviewing relevant scientific studies, and examining existing theories. This paper seeks to build a connection and deeper understanding of the way the musical structure of Gurmat Sangeet contributed not only to spiritual resonance, but also emotional well-being and cognitive response.

1.1 Objective:

Special attention is given to the neurological processes involved in musical processing. By integrating raag theory with the current findings in the field of neuroscience, this study aims to clarify how the surs shape mental and emotional experiences in the specific context of Sikh devotional music.

1.2 Limitations:

Several limitations must be acknowledged in the completion of this study:

First, while there are thirty-one primary raags in the Guru Granth Sahib, each with unique combinations of *shudh* and *vakrit* surs, this paper will only focus on a select few due to limited time. As a result, raags that are less frequently performed or researched may not be fully represented in this analysis.

Second, there is limited existing academic literature specifically addressing the neurological effects of Gurmat Sangeet. Much of the neuroscientific discussion is drawn to broader studies in Indian Classical Music and general music cognition. While these sources provide valuable information, they do not fully capture the unique spiritual aspects of Gurbani Kirtan.

Despite these limitations, however, this study offers valuable information on how Gurmat Sangeet impacts the human brain and has the power to be able to inspire future research on similar topics.

1.3 The Complexities Behind the Brain and the Shudh and Vakrit Surs:

Advances in neuroscience have further highlighted the profound impact Indian classical music has on the human brain. Research shows that listening to this form of music activates several areas, particularly those linked to emotion, memory, and reward processing [4].When it comes to Gurmat Sangeet, studies have shown that the structural framework of its raags, when combined with the spiritual setting of kirtan, provokes distinct patterns of brain activity. This often results in higher states of tranquility, emotional balance, and heightened consciousness [5].

The limbic system, comprising the amygdala and hippocampus, is particularly stimulated when people hear music, thus linking the auditory experience to emotional memory and affective reaction [6]. In this context, both *shudh* (pure) and *vakrit* (altered) surs have important roles to play in determining the emotional meaning of a raag. These subtle changes in pitch, achieved through exact microtonal intervals, can potentially activate neural routes associated with particular emotional responses [7].

Shudh surs are commonly associated with feelings of clarity, hope, and peace. As they stimulate regions of the brain like the ventromedial prefrontal cortex, which is implicated in reward mechanisms, compassion, and positive emotional experience [8]. *Vakrit* surs, on the other hand, which contain komal (flat) and teevra (sharp) notes, add an emotional complexity that can stir spiritual longing, tension, and reflective thought [9]. These specific notes activate deeper emotional areas of the brain, including the amygdala and insular cortex, both of which are integral to affective depth and self-reflective awareness [10]. Research on Indian classical forms indicates that microtonal changes in *vakrit* surs create greater emotional salience by virtue of heightened limbic activation [11]. For example, Raag Gujri, which makes extensive use of *vakrit* notes,ands is often identified with feelings of separation and longing, while Raag Asa, which consists mainly of *shudh* notes, is often used in morning kirtans to spread optimism and spiritual clarity [12].

The emotional effects seen here are an example of a phenomenon called the "energetic tension and resolution cycle," where different tonal structures engage top-down emotional regulation mechanisms [13] .This mechanism not only enhances emotional processing but can also create a meditative or transcendental state of awareness in the auditory recipient [14].

1.4 Analysis of Selected Raags:

Raag Asa, traditionally sung during the morning hours, is structured using *shudh* surs (pure) and evokes a feeling of hope and courage. The aroh (ascending scale) and avroh (descending scale) follow a simple structure: Sa Re Ma Pa Da Sa'/ Sa' Ni Dha Pa Ma Ga Re Sa Re Ga Sa. Its simplicity allows it to produce a regulated and peaceful state for the listeners [15].

From a neuroscientific lens, this "tonal stability" engages the parasympathetic nervous system, calming the body and encouraging focused attention [16]. The reliance on the *shudh* surs with zero *vakrit* and *komal* surs supports a sense of "predictability" which research suggests reduces cortisol levels and enhances cognitive clarity [17]. Which aligns with Raag Asa's role in Gurbani Kirtan as a raag that urges listeners toward inner transformation and optimism [15].

Raag Maru, traditionally performed in the late morning, is composed using *vakrit* surs in the aroh and avroh order [18]. Its ascending and descending (aroh & avroh) emphasize the tivar ma and complex phrases like ma Pa da Ni da Pa. This phrasing generated a sense of tension and yearning for transcendence [18] .

From a neuroscientific lens, the unpredictability of Raag Maru's structure activates the brain's reward and prediction error systems, within the limbic system and dopaminergic pathways [23]. These responses to the melodic structure link to deeper emotional reflection [17]. The *vakrit* notes increase existential awareness, thus making raag maru ideal for shabads focusing on longing and detachment, and inner spiritual conflict, which in turn allows the listeners to reach for a deeper meaning when hearing this specific raag [18].

The final Raag, Raag Bhairo, is typically sung in the first pehar of the day and uses komal notes re and dha, which produce a heavy and solemn space [19]. The aroh and avroh: Sa re Ga Ma Pa da Ni Sa, Sa Ni da Pa Ma Ga re Sa- establish a grounded emotional tone evoking devotion, authority, and surrender [19].

From a neuroscientific lens, the use of lower frequencies and steady swar transitions in Raag Bhairo engage the brainstem and promote parasympathetic activation, which calms the body and encourages emotional regulation [20]. The stability of the raag mirrors the brain's response to authoritative, low-pitched sounds, which enhance focus. Which aligns with Bhairo's use in Gurbani Kirtan as a raag that cultivates humility, following the Hukam (divine will) and a meditative mindset filled with devotion to the Guru (God) [20].

Comparative Table of Raags Summary				
Raag	**Time Performed**	**Mood/Emotional Effect**	**Surs Used**	**Neuroscientific Impact**
Asa	Sunrise and Sunset	Optimism, clarity, resolve	Shudh only Sa Re Ma Pa Da Sa'/ Sa' Ni Dha Pa Ma Ga Re Sa	Activates parasympathetic system; reduces cortisol; promotes focus
Maru	3rd Pehar of the Day	Tension, longing, spiritual questioning	Vakrit sur-ma Sa Ga Ma Pa Da Ni Sa'/ Sa' ni Da Pa, ma Pa da Ni da Pa, Ma Ga Re Sa	Engages limbic/dopaminergic systems; deepens introspection
Bhairo	1st Pehar of the Day	Devotion, surrender, emotional grounding	Komal Re, Komal Dha Sa re Ga Ma Pa da Ni Sa/ Sa Ni da Pa Ma Ga re Sa	Activates brainstem; encourages calm, humility, and focus

In each of the cases the chosen raags's specific emphasis on the *shudh* and *vakrit* surs are carefully used to match the content of the shabad which follow a specific raag, thus enhancing the listeners emotional engagement. By bringing together the findings from raag theory and cognitive neuroscience, this analysis of the raags provide the basis for inspiration for further interdisciplinary research

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