

A Mandibular-maxillary Precedence Field in Tooth Eruption

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In many respects, the dentition behaves in accordance with "field" theory, here defining a "field" as an area of statistical communality, as first introduced with respect to crown size by Butler (*Proc Zool Soc* 109:1-36, 1939). Field theory has since been applied with success to odontogenesis, to calcification and movement, to agenesis, and to tooth emergence (Garn *et al.*, *Nature*, 200:488-489, 1963; Garn, *Nature*, 24: 1501-1502, 1966; Burdi *et al.*, *J Dent Res*, 55: 309, 1976). It follows, therefore, that relative timing between the jaws and mandibular-maxillary precedence should also demonstrate a field effect, such that a group of teeth in the mandible or maxilla is systematically advanced or retarded relative to their opponents. To test this possibility we explored mandibular-maxillary precedences in a total of 160 boys and girls in the University of Michigan Longitudinal Series using serial cast data (Moyers *et al.*, *Standards of Human Occlusal Development*, Ann Arbor Center for Human Growth, 1976). Attention was given to the relative timing of P₁ and P¹ and P₂ and P², as well as those cases where emergence was more nearly synchronous. Each participant was categorized as mandibular precedence, maxillary precedence, or indeterminate (*i.e.*, bunched), leading to a total

of nine categories in all. The question was whether mandibular or maxillary precedence of P₁ was associated with mandibular or maxillary precedence of P₂, which could not be ascertained by correlational methods or by simple enumeration of frequencies (Israel *et al.*, *Arch Oral Biol*, 13:239-241, 1968).

As shown in the Table, there is a strong association in the direction of jaw precedence for both P₁ and P₂. Boys and girls with mandibular precedence of P₁ tend toward mandibular precedence of P₂ and *vice versa*. Participants with the (rarer) maxillary precedence of P₁ tend toward maxillary precedence of P₂. The association also holds for indeterminate or "bunched" emergence precedences. Overall, the association is highly significant by the Chi-squared test ($\chi^2 = 34.7$ with 4 degrees of freedom, $p < .001$). P₁ and P₂, therefore, constitute a field with respect to mandibular precedence, maxillary precedence, or more nearly synchronous emergence.

Clearly, there is an emergence field governing relative timing of opponents in the two jaws, just as there is an emergence field linking the relative emergence timing of teeth within jaws (Garn and Smith, *J Dent Res*, in press). With these new additions we can now extend the list of known and verified fields to include individual teeth, morphological classes, opponents and antimeres, jaws, and distance, as well as fields surrounding hypoplastic or missing teeth. This model, showing the systematic nature of inter-jaw precedence, extends our knowledge of emergence timing to include relative timing of opponents and the ability to predict which of a pair of opponents will emerge first.

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TABLE
ASSOCIATION IN MAXILLARY-MANDIBULAR PRECEDENCES

Precedence of P ₁	Precedence of P ₂		
	Maxillary P ² P ₂	Tied (P ² P ₂)	Mandibular P ₂ P ²
Maxillary precedence - P ¹ P ₁	4	7	1
Uncertain or tied - (P ¹ P ₁)	17	44	22
Mandibular precedence - P ₁ P ¹	2	21	46
Chi-squared (χ^2)			35*

*Coefficient of contingency equals 0.42.