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A Comparison of Two Systems That Code Infant Affective Expression

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The Monadic Phases Coding System (MP) and the Maximally Discriminative Facial Movement Coding System (MAX) are both widely used to define and quantify categories of infant affective behavior. To evaluate the validity of extrapolating research findings from one system to another, we used both systems to code videotapes of 12 four-month-old infants engaged in mother–infant interaction. Interobserver agreement was higher with MP; interobserver reliability was equivalent. Point estimates for the percentages of negative and positive, but not interest, expressions were equivalent. MP and MAX generally agreed about the type of expression presented. Intersystem correlations supported the concurrent, but not discriminant, validity of MP and MAX categories. Interest expressions were not orthogonal to negative and positive affect.

The Monadic Phases Coding System and the Maximally Discriminative Facial Movement Coding System (MAX) are both widely used to define and quantify categories of infant affective behavior. Their applications result in similar affect codes, but the two systems are quite different procedurally. The Monadic Phases System (Cohn & Tronick, 1987; Tronick, Als, & Brazelton, 1980) measures infant affect by combining information about gaze, facial and vocal affective expression, posture, and type of activity (e.g., interacting with an object, a person, or neither). The affect categories derived from MAX (Izard, 1983), on the other hand, are based on facial expression only. Monadic Phases coding is more comprehensive but is also more general. Whereas Monadic Phases does not discriminate among regions of the face, MAX differentiates three facial regions (forehead and brows, midface, and mouth) and discriminates among types of movement within each region. Combination rules translate facial movement codes into expressions of affect.

Both systems are widely used to investigate similar research problems, for example, the relation between affective expression and infants' age, sex, and birth status, the type and direction of influence between mothers' and babies' affective expression (Monadic Phases: Cohn & Tronick, 1987, 1988a; Lester, Hoffman, & Brazelton, 1985; Tronick & Cohn, 1989; MAX: Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986; Malatesta & Haviland, 1982), and infant affective response to experimental or other manipulations (Monadic Phases: Cohn & Tronick, 1983; Cohn & Elmore, 1988; Tronick, Als, Adamson, Wise, & Brazelton, 1978; MAX: Izard, Hembree, Dougherty, & Coss, 1983; Stenberg, 1982). Investigators initiating research in any of these areas are likely to consider using one or the other of these systems. However, because Monadic Phases and MAX have never been directly compared, a choice between them cannot be made on direct empirical grounds. Moreover, the validity of extrapolating research findings from one system to the other remains unknown.

Both systems provide measures of negative, positive, and intermediate affective expression. At least four types of intersystem comparison are relevant. First, are codes for similar expressions equally reliable in each system? Second, do the systems provide equal point estimates for the average percentage of time that comparable expressions occur in a group of subjects? Third, do the systems agree on a moment-to-moment basis about the type of affective expression shown? Fourth, is the rank order of infants' summary scores for positive, negative, and interest expressions similar in each system? Summary measures might be highly correlated, yet agreement on a moment-to-moment basis might be low (cf. Tinsley & Weiss, 1975).

Concurrent validation studies are useful to evaluate the general comparability of different systems, to suggest the relative advantages or disadvantages of either system, and to contribute to construct validity. To compare Monadic Phases and MAX, we used both systems to code infants' behavior during 3 min of face-to-face interaction with their mothers.

Method

Subjects

Videotapes of 12 infants who were subjects in a larger study were randomly selected. These infants, who had been identified from published birth reports, were full-term, healthy babies with a mean age of 18.2 weeks (SD = 1.5 weeks).

Setting and Equipment

The videotaping of face-to-face play took place in a laboratory equipped with an infant seat that was placed on a table, a stool for the mother, two videocameras, and a microphone. One camera was focused on the mother, and the other on the infant. The video output was transmitted into an adjoining recording room where the output from each camera was combined by a split-screen generator, and a digital time code was added. The resulting video and audio output was recorded using a Panasonic videocassette recorder.

Procedure

For the face-to-face interaction, mothers were asked to play with their baby as they would if they were at home. Mothers were asked not to use

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pacifiers or toys or to pick up their infant during the face-to-face play. Interactions were of 3-min duration.

Coding

Monadic Phases coding followed the system described by Tronick, Cohn, and colleagues (Cohn & Tronick, 1987; Tronick, Krafchuk, Ricks, Cohn, & Winn, 1980), which is a revision of a system described by Tronick, Als, and Brazelton (1980). The principal difference in the revised system is that all expressive modalities (e.g., face, voice, etc.) are scored on one viewing of the videotape. In the original system, a separate viewing of the videotape was required for each modality of expression. The Monadic Phases were *protest, avert, object attend, social attend, play,* and *positive away* (see Appendix for descriptions). *Play* included instances of positive vocalizations, which in the original system were coded separately as *talk.*

MAX affect expressions are a function of particular combinations of facial movements in three regions of the face: brows and forehead, eyes and cheeks, and mouth. Movement in each region was scored on separate passes of the videotape, using the codes detailed in the MAX manual (Izard, 1983). The principal affective expressions were *pain, sad, interest, joy, surprise,* and two blends, *interest/sad* and *interest/joy* (see Appendix). Instances in which there was no observable movement in the infant's facial expression (i.e., *no movement*) were also coded.

We used two coders, one for Monadic Phases, and one for MAX. They worked independently and coded the videotapes using a stop-frame procedure. Whenever a change in phase (Monadic Phases) or facial movement (MAX) was observed, the videotape would be reversed and replayed at full and at slow speed to confirm the occurrence and type of change. Times, read from a digital time display recorded on the videotape, were rounded to the nearest .5 s.

Data Reduction

We did not analyze MAX discrete emotion expressions (e.g., *anger*) that occurred less than .5% of the time or blends that occurred less than 1% of the time. The exclusion limit for blends was higher than that for discrete expressions to reduce the risk of including expressions that may represent only timing error across the three facial regions.

Monadic Phases and MAX discriminate among types of negative and positive affect expression. The construct validity of some of these discriminations in young infants is controversial (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983; Camras, 1988; Fogel, 1988). To increase validity and facilitate comparison, we pooled across related expression categories. Monadic Phases *negative* consisted of *protest.* Monadic Phases *positive* consisted of *play, object play,* and *positive away.* MAX *negative* consisted of *sad, pain,* and *interest/sad. Object attend* and *social attend,* which are similar to MAX *interest,* were combined as *attend.* MAX *positive* consisted of *joy, surprise,* and *interest/joy.* Thus, for each system we had a fourfold classification: *negative, positive, attend,* and *avert* within Monadic Phases and *negative, positive, interest,* and *no movement* within MAX.

Pooling was informed by previous research. For example, sad and pain are both considered negative affects (Malatesta & Haviland, 1982). Similarly, the MAX expressions of joy and surprise and the Monadic Phases of play all imply positive affect and have been considered to represent positive expression in prior research (Cohn & Tronick, 1987; Malatesta & Haviland, 1982). Attend suggests interest in the mother or an object (Cohn & Tronick, 1987; Tronick, Als, et al., 1980). Both Monadic Phases attend and MAX interest include an especially wide range of similar facial expressions (as can be seen in the Appendix).

Avert within Monadic Phases and no movement within MAX have no direct counterpart within the other system. Avert is defined primarily in terms of visual orientation rather than affect and includes both mild negative and neutral expressions. What Monadic Phases codes as avert might be coded by MAX as negative, interest, or no movement. Within MAX, expressions coded as no movement might occur within either avert or attend.

We used the fourfold classification to compare the two systems. We also conducted comparisons involving the subcategories of MAX. We did not make comparisons involving subcategories of Monadic Phases, because they differed primarily in terms of visual orientation rather than affective expression (e.g., social attend and object attend or play and positive away).

Results

Reliability

For comparison, 6 of the 12 interactions were randomly selected and independently recoded. The original MAX coder, who was also trained in Monadic Phases, recoded these interactions using Monadic Phases. MAX recoding was performed by a research assistant trained in MAX only. We computed measures of both interobserver agreement (for the coding of expressions on a moment-to-moment basis) and interobserver reliability (for summary scores), because the two sets of measures are independent (Tinsley & Weiss, 1975).

Interobserver agreement was estimated by computing kappa coefficients (Cohen, 1960) on agreement between original and comparison coders. An agreement was counted when both coders agreed within .5 s on the occurrence of an expression. For Monadic Phases, kappa coefficients were .70 for negative, .69 for avert, .66 for attend, and .77 for positive. The overall kappa, computed from the 4×4 interobserver matrix for the four Monadic Phases was .71. MAX kappa coefficients were .87 for negative, .64 for no movement, .56 for interest, and .61 for positive. The overall kappa for these four composite MAX expressions was .62, which was significantly lower ($p < .01$) than that for Monadic Phases.

Interobserver reliability was estimated by correlating the original and comparison observers' scores for the percentage of time each expression occurred. For Monadic Phases, interobserver correlations were .99 for negative, .75 for avert, .97 for attend, and .93 for positive. For MAX, interobserver correlations were .95 for negative, .36 for no movement, .84 for interest, and .94 for positive. All correlation coefficients, with the exception of that for no movement, were significant and acceptable by conventional criteria. Reliability for interest was less than that for attend, but, because of the small number of subjects for whom reliability data were available, we were unable to test the significance of the difference.

Percentage of Time That Categories for Comparable Expressions Occurred Within Each System

The entry *uncodable* represents the percentage of time in which there was insufficient information to classify an expression. For instance, this could occur when the mother's arm temporarily blocked the view of the camera that was recording the infant's behavior. Monadic Phases and MAX require different types of information (as outlined earlier). To classify an expression, MAX requires that all three regions of the face be viewable, whereas, in Monadic Phases, the face may be entirely out of view and phase still be codable (e.g., avert). MAX produced a significantly greater proportion ($p < .01$) of uncodable data.

Point estimates for the mean percentage of negative and posi-

Table 1
Relative Percentages of Coded Expressions

MAX		Monadic phases		t
Negative	3.6	Negative	5.1	.79
Pain	1.5	Protest	5.1	
Sad	.6			
Interest/sad	1.5			
No movement	9.2	Avert	16.2	na
Interest	25.9	Attend	52.2	3.78*
		Object attend	12.9	
		Social attend	39.3	
Positive	11.8	Positive	14.5	1.75
Joy	5.8	Object play	.9	
Surprise	.8	Social play	12.7	
Interest/joy	5.2	Positive away	.9	
Uncodable	43.5	Uncodable	12.0	4.60*

Note. na = Not applicable. Percentages for MAX do not sum to 100: discrete expressions occurring less than .5% and blends occurring less than 1% were excluded. Percentages were derived by computing the sum of occurrences for each expression divided by the length of the interaction.
* $p < .005$.

tive expressions did not significantly differ. The Monadic Phases estimate of interest (i.e., attend) was significantly greater than that of MAX (see Table 1).

Agreement Analyses

To assess whether Monadic Phases and MAX classified expressions similarly, data files for each system were organized so that it was possible to compare the codes on a moment-to-moment basis. Codes were then cross-classified, which allowed for inspection of the frequency distribution of codes in either system in relation to those in the other (i.e., what is the pattern of agreements and disagreements?). To minimize the influence of timing errors, we counted as agreements instances in which the following combinations occurred within .5 s: MAX negative, pain, sad, and interest/sad with Monadic Phases negative (i.e., protest); MAX positive, joy, surprise, and interest/joy with Monadic Phases positive; and MAX interest with Monadic Phases attend. We also used the same criterion for MAX no movement with Monadic Phases attend and avert. Observations that were uncodable using either system were treated as missing values and were not cross-tabulated.

To assess the level of agreement, kappa coefficients were computed for each pair of codes in Table 2. Intersystem agreement was highest for negative and positive affect expressions. For MAX and Monadic Phases negative, kappa was .77. Expressions coded by MAX as pain were the ones most consistently coded negative by Monadic Phases. The kappa for MAX and Monadic Phases positive was .82. Both joy and interest/joy, but not surprise, were coded in Monadic Phases as positive. The kappa coefficient for the interest–attend comparison was significant but lower than that for negative–negative and positive–positive comparisons ($p < .01$). We found no indication that any of the 22 distinct combinations of facial movement that make up interest were more likely to be classified by Monadic Phases as attend rather than avert.

Table 2
Joint Frequency Distribution of Monadic Phases and MAX Categories

	Monadic phases			
MAX	Negative	Avert	Attend	Positive
Negative	119 (.77)	11	41	0
Pain	79 (.73)	2	0	0
Sad	12	4	9	0
Interest/sad	28 (.26)	5	32	0
No movement	2	222 (.49)	171	2
Interest	11	130	1059 (.59)	78
Positive	1	12	67	492 (.82)
Joy	0	7	34	228 (.46)
Surprise	0	3	9	19
Interest/joy	1	2	24	245 (.51)

Note. Significant kappa coefficients ($p < .01$) appear in parentheses. Nonsignificant kappas are omitted.

Correlational Analyses

Similar categories within systems were moderately correlated (Table 3). The correlation between Monadic Phases and MAX negative was .55 ($p < .05$) and was due to the strong association between MAX pain and Monadic Phases negative (i.e., protest). Other subcategories within MAX negative were unrelated to Monadic Phases negative. The correlation between Monadic Phases and MAX positive was .67 ($p < .01$). MAX interest/joy and Monadic Phases positive were strongly correlated ($r = .85, p < .01$). Joy and surprise were uncorrelated with Monadic Phases positive. The correlation between attend and interest was .77 ($p < .01$).

We found several significant off-diagonal correlations. Monadic Phases positive was negatively correlated with interest. MAX interest was negatively correlated with Monadic Phases positive. MAX negative and Monadic Phases avert overlapped, as suggested by both their marginally significant correlation ($r = .48, p < .10$) and the significant and strong correlation between MAX pain and Monadic Phases avert.

Some investigators have scaled Monadic Phases along a nega-

Table 3
Intersystem Correlation Coefficients for MAX and Monadic Phases

	Monadic phases			
MAX	Negative	Avert	Attend	Positive
Negative	.55*	.48	−.61*	.13
Pain	.77**	.81**	−.55*	−.41
Sad	.24	−.15	−.25	.38
Interest/sad	.27	−.11	−.28	.36
No movement	.25	.36	−.32	−.01
Interest	−.14	−.52*	.77**	−.57*
Positive	−.38	.11	−.37	.67**
Joy	−.08	−.06	−.23	.45
Surprise	−.33	−.02	.08	.09
Interest/joy	−.47	.16	−.49	.85**

* $p < .05$. ** $p < .01$.

tive-to-positive affective dimension (Cohn & Tronick, 1988a, 1988b; Lester et al., 1985) from protest to positive. MAX categories have also been treated in this way (Langsdorf, Izard, Rayias, & Hembree, 1983). To compare the systems when categories are expressed as ordinal values, we assigned scaled scores to the Monadic Phases and MAX categories. For Monadic Phases the scale was as follows: 1 = *negative*, 2 = *avert*, 3 = *attend*, and 4 = *positive*. (Both Cohn and Tronick, 1988a, and Lester et al., 1985, used a similar scaling of Monadic Phases.) Scaled scores for MAX were as follows: 1 = *negative*, 2 = *no movement*, 3 = *interest*, and 4 = *positive*. The correlation coefficient for scaled scores was .57 ($p < .01$). The scaling of Monadic Phases and MAX was a priori, and other ways of scaling the two systems might be more valid or produce different results (cf. Fogel, 1988).

Discussion

The generalizability of any system to describe behavior is related to the consistency with which it can be applied. We investigated two major sources of error variance: interobserver reliability and interobserver agreement. Interobserver reliability coefficients for negative, positive, and interest codes ranged from .84 to .99, and did not differ between systems. The reliability of two other codes, avert and no movement, was lower. No movement, which is not a discrete emotion but is coded in the course of using MAX, was found to be unreliable. One possible explanation may be the small number of videotapes that we recoded for reliability purposes. Had we recoded more than six interactions, the reliability of no movement might have been greater. We propose, however, that the unacceptable reliability of no movement was related to its lack of construct validity (which we discuss below). In any case, the more important finding is that reliability coefficients for the three major categories—negative, positive, and interest—were all highly acceptable.

Interobserver agreement was higher with Monadic Phases. This was due to the lower level of interobserver agreement for MAX interest and positive than for Monadic Phases attend and positive. However, the absolute size of the differences in kappa coefficients between systems for similar categories and overall was not large.

The extent to which our findings on reliability and agreement can be compared with those of others is limited. We know of no studies that have reported reliability coefficients for summary scores in either system. Typically, only agreement, uncorrected for chance, is reported. Some studies have reported chance-corrected agreement for infants' Monadic Phases. Cohn and Tronick (1988a) reported a kappa of .72, which was almost identical with what we found. Cohn and Elmore (1988) reported a higher kappa of .82. We know of no studies using MAX that have reported chance-corrected measures of interobserver agreement. Clearly, a more uniform standard is needed in this area.

One appreciable difference between Monadic Phases and MAX was the greater percentage of expressions that could not be coded with MAX. MAX requires that all three regions of the face be visible; missing data results when the baby turns away from the camera or the mother blocks the camera's view. Monadic Phases was less affected by such occurrences, because many of the phases could be coded with either some or all of the face out of view. Large amounts of missing data would make some types of data analysis, especially time-series methods (Cohn & Tronick, 1988a; Lester et al., 1985), impossible and substantially reduce the effective sample of behavior on which measures of central tendency are based. The choice of coding systems should be guided in part by the procedures for videotaping.

The two systems agreed closely on the percentage of time that negative and positive expressions occurred. Monadic Phases produced higher estimates for interest expressions, but the reason for this difference was not clear. Interobserver reliability for interest expressions in both systems was high, and differences in absolute agreement would not have influenced summary measures. Analysis of Table 1 suggests that expressions coded by Monadic Phases as indicating interest (attend) may have been uncodable with MAX or were coded as no movement. Because we chose to omit from the intersystem agreement analyses those expressions that were uncodable by either system, however, we can only speculate about the relation between uncodable expression in MAX and Monadic Phases attend.

We found moderate agreement between composite negative and positive codes for MAX and Monadic Phases; agreement for interest expressions, on the other hand, although still acceptable, was lower. The difference with respect to interest expressions may reflect the heterogeneity of facial expressions within interest and attend: MAX interest included 22 distinct facial expressions, and the number of distinct facial expressions within attend, although not so easy to quantify, was certainly as broad. Both interest and attend include expressions varying from mildly negative to mildly positive. Heterogeneity within a category makes agreement among observers more difficult, and *intra*system disagreement may have attenuated *inter*system agreement. Nevertheless, lack of construct validity for expressions of intermediate affect may have been a contributing factor.

Campbell (1960) proposed that to demonstrate construct validity a test will correlate highly with variables with which it is theoretically related (convergent validity) and not correlate with variables with which it is expected to differ (discriminant validity). We found that Monadic Phases and MAX possessed moderate convergent validity for negative, positive, and interest expressions. Summary scores for each of these expressions were correlated in the range of .55 to .77. Moreover, scaled scores were moderately correlated. Thus, we found acceptable convergent validity for Monadic Phases and MAX as measures of negative and positive affect and interest.

Some, but not all, subcategories also had acceptable convergent validity. Pain, but not sad or interest/sad, was correlated with Monadic Phases negative. Interest/joy, but not joy or surprise, was correlated with Monadic Phases positive. In cases where we failed to find evidence for the convergent validity of subcategories, the correlations may have been attenuated because the subcategories occurred infrequently. Nevertheless, our data suggest the need for caution in making inferences from MAX subcategories to more global constructs.

A necessary condition for discriminant validity is that dissimilar categories be uncorrelated. This condition obtained for Monadic Phases negative and MAX positive but not for Monadic Phases avert, attend, and positive or MAX interest, all of which were correlated with at least one dissimilar category. Our failure to find greater evidence of construct validity was not unexpected, of course, because the coding criteria for several categories are heterogeneous and related. Avert, like attend and interest, includes mildly negative to neutral expressions; *attend* and *interest* include both mildly negative and mildly positive expressions. Previous work has questioned the construct validity of some subcategories within Monadic Phases or MAX (Campos et al., 1983; Camras, 1988; Fogel, 1988). Our data go further and question the construct validity of more global categories as well. Monadic Phases and MAX appeared to overestimate the number of truly independent emotion categories.

Our failure to find more compelling evidence of construct validity may be interpreted in several ways. One is that one coding system or the other is faulty. MAX was developed to measure "fundamental emotions" (Izard & Schwartz, 1986), but the theory behind Monadic Phases characterized affective experience as both discrete and dimensional, hypothesizing that discrete states, or phases, could be ordered in terms of their intensity or *degree* of negative or positive affect (Brazelton, Koslowski, & Main, 1974; Cohn & Tronick, 1988a, 1988b). Thus, Monadic Phases and MAX have different theoretical backgrounds. Had we compared MAX with a coding system such as Ekman's Facial Action Coding System (FACS; Ekman & Oster, 1979), which, like MAX, is intended to measure presumably discrete affects only and not dimensional changes as well, we might have found more convincing evidence for the construct validity of multiple categories of affective experience.

Because we did not include FACS in our comparisons, we cannot reject the possibility that evidence for discriminant validity would have differed had we done so. Nevertheless, we do not find this possibility compelling. Heterogeneity and breadth of categories are common to both Monadic Phases and MAX, and both systems consistently coded expressions similarly. Concurrent validity coefficients were also moderate to strong. Moreover, the moderate intercorrelations we found among dissimilar categories, which contraindicate discriminant validity, were consistent with much of the research on self-reported affect. Zevon and Tellegen (1982, cited in Watson & Tellegen, 1985) found that factors corresponding to Izard's (1977) fundamental emotions were intercorrelated and could be accounted for by two primary, orthogonal factors, which they labeled *negative* and *positive affect.* Watson and Tellegen (1985) conducted meta-analyses of a large number of studies of self-reported affect and found that these two factors "consistently emerge as the first two rotated dimensions in orthogonal factor analyses, or as the first two second-order factors derived from oblique solutions" (p. 231).

The intersystem correlations in our study were consistent with the finding of Watson and Tellegen (1985) that negative and positive affect represent two primary bipolar dimensions of affective experience. Specifically, we found that categories representing intermediate affect (mildly negative to mildly positive) correlated with both negative and positive affect categories, but the latter were uncorrelated with each other. Our interpretation is that different components of avert, attend, and interest represent intermediate values along one or the other of these two primary dimensions. The implications of this view for theories that emphasize the discrete nature of affective experience (Ekman & Oster, 1979; Fogel, 1988; Izard, 1977; Tomkins, 1984) require further study.

The discrete emotions approach (Ekman & Oster, 1979; Izard, 1977; Izard & Schwartz, 1986), in emphasizing what is distinctive, has said relatively little about variance that is shared across affect categories. Thus, we know much more about differences than we do about commonalities. Data are needed about both. The discrete emotions approach may have led also to the arbitrary classification of some facial expressions, because within that framework an expression must be classified as either a discrete affect or a blend of discrete affects. Expressions cannot be classified as merely positive or negative. This may have resulted in the forced classification of some expressions (consider, for example, the heterogeneity of the interest category). The psychological interpretation of blends from a discrete emotions perspective is also problematic, and, for this reason perhaps, blends are often disregarded. A hierarchical model would allow for greater flexibility in the description of emotional experience.

One further implication is that, in many applications, investigators may seriously increase their risk of Type II error by failing to pool related categories. If interest and joy, for instance, both represent positive affect, then separately analyzing summary scores for these categories will provide a less powerful test of a given hypothesis then would analysis of a pooled measure of positive affect. Investigators should make an informed decision—on the basis of their hypotheses rather than on the a priori categories of their coding systems—about whether to pool related categories. Note, however, that the ideal pooling procedure would be one that differentially weighted categories according to their intensity rankings along the negative or positive affective dimension. How best to accomplish such weighting is a matter for further research.

In summary, interobserver reliability did not vary between systems, but interobserver agreement for Monadic Phases was higher than that for MAX. Differences in the systems' coding procedures resulted in a higher percentage of uncodable observations with MAX. Point estimates for the percentages of negative and positive, but not interest, expressions were equivalent. Monadic Phases and MAX showed acceptable levels of agreement for the occurrence/nonoccurrence of negative, positive, and interest expressions provided that the expressions could be coded by each system. The rank ordering of subjects' summary scores for negative, positive, and interest expressions (concurrent validity) were consistent between systems, but intersystem correlations failed to support the discriminant validity of Monadic Phases and MAX categories. Rather, the intercorrelations suggested that the categories might be conceptualized more validly as representing two bipolar dimensions: negative and positive affect.

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Appendix

Descriptions of Monadic Phases and MAX Categories

Monadic Phases

Protest. Strong negative facial expressions (i.e., strong cry), crying, or fussy vocalizations, including attempts to orient body, head, and eyes away from the partner.

Avert. Mild negative facial expressions (i.e., slight grimace, pout, wary, frown) or neutral expression. These facial expressions occur in conjunction with a partial or complete turning of body, head, or eyes away from the partner and not toward an object.

Object attend. Mild negative (i.e., slight grimace, pout, wary, frown), neutral, or bright (raised brows, wide eyes) facial expressions with orientation of head, body, and eyes toward an object. Object may be self, apparel, or inanimate (e.g., strap or side of infant seat).

Social attend. Mild negative (i.e., slight grimace, pout, wary, frown), neutral, or bright (raised brows, wide eyes) facial expressions with orientation of head, body, and eyes toward the partner.

Object play. Same as social play, but gaze is away from partner and toward an object. Object may be self, apparel, or inanimate (e.g., strap or side of infant seat).

Positive away. Same as social play, but gaze is away from partner and not toward an identifiable object such as self, apparel, the strap or side of infant seat.

Social play. Facial expression is one of the smile or play faces (i.e., oval shaped mouth as in surprise). Expressions may be accompanied by laughing vocalization (talk) with orientation of body, head, and eyes toward the partner.

MAX

Pain. Brows drawn sharply downward and together, nasal root broadened, vertical furrows or bulge between brows; eyes tightly closed with cheeks raised; rectangular or squarish mouth, wide open, tense mouth.

Sad. Inner corners of brows raised in triangular shape, bulge, or vertical wrinkles between inner corners of brow, upper eyelid pulled up at the inner corner; eyes squinted, cheeks raised; corners of mouth drawn downward and outward, center of lower lip pushed upward.

Interest. Brows can either be raised, in normal shape, or drawn together and/or slightly lowered; eyes may be either widened, roundish in appearance, or squinted; cheeks may be raised; mouth can be opened and relaxed, tongue may be extended beyond the gum line, lips may be pursed. Twenty-two distinct combinations of facial movement codes conformed with these criteria and occurred more than .5% of the time.

Joy. Brows are in their normal shape (neither raised nor lowered); cheeks raised; corners of mouth drawn back and upward.

Surprise. Brows are raised in normal shape; eyes appear widened, roundish in appearance; mouth opened in oval or roundish shape.

Interest/sad. There were three types of expressions that were coded as interest/sad blends: (a) inner corners of the brows raised in triangular shape with an opened relaxed mouth, (b) inner corners of the brows raised in a triangular shape with cheeks raised and tongue extended beyond the gum line, and (c) brows drawn together and slightly lowered with corners of the mouth drawn downward and outward.

Interest/joy. There were four types of expressions coded as interest/joy blends: (a) eyes narrowed with cheeks raised and corners of the mouth turned upward, (b) cheeks raised with corners of the mouth turned upward and tongue extended beyond the gum line, (c) brows raised in their normal shape, eyes are roundish in appearance with corners of the mouth turned upward, and (d) brows narrowed and slightly lowered with corners of the mouth turned upward.

No movement. No movement observed in any of the three facial regions.

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