

CROWDING AND CHILDREN'S MENTAL HEALTH: THE ROLE OF HOUSE TYPE

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Abstract

An important and largely unstudied aspect of the apparent relation between residential crowding and mental health is the potential role of environmental design to moderate this relation. An epidemiological investigation reveals that the type of housing children inhabit alters mental health correlates of residential crowding. Third and fourth grade Austrian children ($n=1,236$) from small towns and agricultural areas who reside in multiple family dwellings manifest significantly stronger associations between residential density and a standardized self-report index of psychological health (KINDL) as well as teacher ratings of behavioral conduct in the classroom (Needleman) in comparison to their counterparts residing either in single family detached homes or in row houses. These findings occur independently of mother's educational level among children residing in relatively low-density housing.

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Most research on crowding and mental health has attempted to uncover direct relations between household density and various indices of psychological well being. Generally, there is good support for the claim that higher levels of interior residential density (people per room) are associated with elevated levels of psychological distress among adults (Marsella *et al.*, 1970; Hassen, 1977; Gove & Hughes, 1983; Gabe & Williams, 1987; Jain, 1987; Evans *et al.*, 1989; Edwards *et al.*, 1990; Lepore *et al.*, 1991). The Lepore *et al.* (1991) study is especially noteworthy because it provides the only prospective, longitudinal evidence for the linkage between crowding and mental health. At initial occupancy, residents of more crowded homes did not differ from their less crowded counterparts in psychological distress. However, at two months occupancy there was such a relationship, and by eight months the strength of the association had grown stronger. This pattern of results argues against a social drift or downwards mobility explanation for the crowding—mental health association. Residential crowding appears to lead to psychological distress and not the other way around.

Although there is less evidence for the mental health sequelae of residential crowding among chil-

dren, indirect data exist. Children in higher density homes experience greater corporal punishment (Booth & Edwards, 1976), higher levels of conflict with family members (Booth & Edwards, 1976; Saegert, 1982; Evans *et al.*, 1998) and reduced parental responsiveness (Bradley & Caldwell, 1984; Wachs, 1989; Evans *et al.*, 1999). Given these impairments in critical parent-child proximal processes (Bronfenbrenner & Morris, 1998), it is not surprising that children from higher density homes manifest more behavioral adjustment difficulties at school (Booth & Johnson, 1975; Saegert, 1982; Evans *et al.*, 1998).

An important and largely unstudied aspect of the apparent relation between household crowding and psychological distress is the potential role of environmental design to moderate this association (Aiello & Baum, 1979; Ineichen, 1993). What role might interior design or architectural variables play in altering the nature of the relations between household crowding and mental health? This study examines whether typical variations in housing type, specifically single family, row house, or multiple unit dwellings, make any difference in how children respond to residential crowding. There is some indirect evidence in the crowding literature to expect that the latter housing type, multiple family

dwelling, might exacerbate negative impacts of residential crowding on children's psychological well being.

One of the major underlying psychological processes that appears to account for some of the negative effects of crowding is loss of control over interpersonal interaction (Altman, 1975; Saegert, 1982). Too much unwanted social interaction is a frequent concomitant of crowding (Baum & Valins, 1977, 1979; Mc Carthy & Saegert, 1979). When interior spaces are designed to foster better regulation of interpersonal contact, residential density seems to have less negative impact. Baum and colleagues in a series of studies have shown that long corridor dormitory designs in comparison to either suites or short corridor designs caused elevated crowding and greater problems with the regulation of social interaction (Baum & Valins, 1977, 1979). Follow-up research revealed that when longer corridor dormitories were redesigned so that the number of residents sharing a common corridor was reduced, the negative crowding effects were attenuated (Baum & Davis, 1980). It is important to note that the students in Baum's studies did not choose their housing accommodations. Cox *et al.* (1982) and Schaeffer *et al.* (1988) found that redesigning prison sleeping areas to enable better regulation of social interaction reduced crowding, improved physical health, and lowered both psychophysiological and self-reported stress. Floorplan configurations that afford greater opportunity for being alone also attenuate the negative impacts of residential density on psychological well being. Evans *et al.* (1996) used spatial syntax analysis to quantify residential floorplans among off campus student housing units. Floorplans with greater depth buffered the crowding-distress relationship. Depth is a measure of the degree of separation between different spaces within a floorplan configuration and predicts social interaction (Hillier & Hanson, 1984).

Residential design can also make a difference in how children respond to crowding. Wachs and Gruen (1982) found that preschool children in more crowded homes manifested delayed cognitive development. Both cross-sectional and longitudinal evidence reflected this trend. Interestingly if these children had access to a room where they could spend time alone, the negative developmental correlates of residential crowding were diminished.

There is also evidence that when children live in larger, multiple family dwelling complexes, emotional well being may be affected. Children living in high-rise, multiple dwelling complexes have higher rates of behavioral problems in comparison to

those residing in single-family homes or smaller, low-rise buildings (Ineichen & Hooper, 1974; Richman, 1977; Saegert, 1982). Rates of juvenile delinquency are also higher among adolescents in multiple dwelling units relative to those in single-family detached homes (Gillis, 1974). Of particular relevance to the present study, the major hypothesis offered to account for the apparent covariation between housing type and children's psychological distress is the relative inaccessibility to playspaces external to the residence. This in turn is believed to lead to young children being cooped up inside with more intra-family conflict and greater social isolation from peers (Halpern, 1995; Evans *et al.*, in press; Gifford, in press).

In the present study, we were able to take advantage of an epidemiological study on environmental quality and children's well being conducted in small towns and rural areas in the Northern Tirol Region of Austria, proximate to Innsbruck. Included in the study protocol were measures of residential density (people per room), housing type (single-family, row house, multiple dwelling unit) and two indices of mental health. Based upon prior research on crowding and architecture as well as on housing, we hypothesized that elementary school children living in high-density homes in multiple dwelling complexes would suffer greater psychological distress than those living in crowded homes that were either single-family detached or row houses. Thus, we predicted an interaction between density and house type on mental health. Another facet of this study warrants brief comment. Unlike previous psychological studies of crowding, the data set is large, consisting of nearly 1300 children. This also enabled us to generate a dose-response function, examining variability in mental health over a range of residential densities typical for this region of Austria and probably for much of non-urban, Western European. To our knowledge, no dose-response data currently exist on residential density and mental health.

Method

Participants

One thousand two hundred and eighty children in grades 3-4 ($M=9.44$ years) were recruited by letters sent to families living in the Inn Valley of Tyrol in Austria. This age group was chosen to correspond to several other studies of environmental quality and children's health (Wohlwill & Heft, 1987; Evans *et al.*, 1991; Evans, 2000). The response rate was 79.5%.

This area consists of small towns and villages with a mix of industrial and agricultural activities in rural areas outside of Innsbruck. About one-third of the sample lives in communities with approximately 6000 inhabitants, 50% in villages at half this size, and the remaining families in small villages and scattered sites. Fifty-one percent of the children were boys. Maternal education was coded along a continuum: basic education (9 years) (26%), additional 2 years of technical/trade school (33%), additional 4 years of university preparatory school (24%), or college/graduate education (15%), and 2% not reported. Twenty-seven percent of the mothers are white collar workers or civil servants, 51% are homemakers, 11% self-employed, and 9% unskilled laborers. Of the 1154 families with complete data on density and house type, 55% of the sample lived in single-family, detached homes, 17% in row houses, and 21% in multiple family dwellings.

Procedure

The data presented here are only a small portion of a larger investigation of environmental quality

and health conducted by the School of Medicine, University of Innsbruck and the Austrian Ministry of Transportation in rural areas in Austria. Results are reported for the entire sample from the environmental quality and health study. In addition to noise and air pollution exposure information, each child's house was classified as single-family, row house, or multiple dwelling unit. Detached homes (see Figure 1a) are occupied by one or two (10%) families. They are more physically separated from other houses relative to the other two housing categories and often (95%) have garden spaces in between them and other units. Row houses (Figure 1b) include attached houses of three to eight units, typically inhabited by one family. Most row houses (82%) have proximate garden spaces, but the grounds are not as spacious as typically encountered among detached homes. Multiple dwelling family units (Figure 1c) are larger buildings holding from three to 25 dwelling units. The highest buildings are 10 stories high but 95% have four floors or less. Only 27% of apartments have adjacent garden spaces but most share common grounds (65%), often incorporating a play area for children. As indicated below, house type is



FIGURE 1. Illustrations of the three types of housing categories: detached, row house and multiple dwelling units

unrelated to social class (mother's education or occupational category). Figure 2 depicts a typical community in the area sampled and also illustrates general living conditions.

Density was determined by dividing the number of people living in the residence by the number of rooms in the home. Bathrooms, storage areas, garages, and hallways were not counted.

Two measures of children's psychological well being from the larger environment and health study are included here. All information was in German and collected by two experimenters (university students). The first measure consists of two subscales of the KINDL (Bullinger *et al.*, 1994) which is an index of quality of life designed for elementary-aged school children in Germany. Extensive psychometric documentation is available for this scale, including one week test, re-test reliabilities exceeding 0.90, measures of internal consistency about 0.80, and both convergent (e.g. midrange correlations between 0.39 and 0.46 with several other longer indices of nonspecific psychological health in children as described by the authors of the KINDL—see below) and discriminant validity (e.g. children with high stressful life events or those exposed to greater, chronic environmental stressors manifest significantly lower KINDL scores). Furthermore, the KINDL is unrelated to school type (private vs public) or specific diseases (i.e. asthma vs diabetes) but is sensitive to children with and without chronic illness (Bullinger *et al.*, 1994; Bullinger & Ravens-Sieberer, 1995; Ravens-Sieberer & Bullinger, 1998). We combined the emotional well-being scale and the functional impairment scale because they were highly correlated ($r = 0.63$) and formed an intern-

ally consistent scale ($\alpha = 0.81$). Furthermore, our data closely match subscale intercorrelations for the KINDL as reported by Bullinger and colleagues (e.g. 0.64–0.67). Scores ranged from 0 = never, 1 = rarely, 2 = sometimes, 3 = often to 4 = very often, with a higher score indicating higher quality of life. Children were administered the KINDL in writing in their own classroom with careful supervision to insure that each child responded independently to the questionnaire.

The second scale was given to each child's teacher and consisted of 11 yes/no questions about behavioral conduct in the classroom. This scale was originally developed by Needleman to measure classroom behaviors in relation to low-level ambient lead exposure in elementary school children (Needleman *et al.*, 1979; Needleman, 1983). The scale has been shown to be sensitive to very small changes in lead levels both cross sectionally (Needleman *et al.*, 1979; Yule *et al.*, 1981; Needleman, 1983; Winneke *et al.*, 1990) and longitudinally from elementary school to high school (Needleman *et al.*, 1990). The Winneke study included primary school samples from eight European countries, including Germany. The 11 item scale was reliable ($\alpha = 0.80$). No prior data on scale reliability are available. Higher scores indicated better functioning in the classroom. The compiled items from both scales are included in the Appendix ¹.

Both teachers and experimenters were blind to the child's home density levels and house type at the time of data collection. Children were informed that this was a study of traffic, environment, and health.

Results

Table 1 provides descriptive data and the intercorrelations among the two scales and the two subscales of the KINDL. These data indicate, as would be expected given our sample of working and middle class children, that overall levels of psychological distress as well as behavioral conduct problems are quite modest. The absolute levels are also comparable to those found for the KINDL with nonclinical samples of similar age (Bullinger *et al.*, 1994; Bullinger & Ravens-Sieberer, 1995; Ravens-Sieberer & Bullinger, 1998) Because Needleman and other investigators have used the Teacher Behavioral Questionnaire with younger children, we cannot directly compare our data to prior information on the (Table 2).

Figure 3 depicts the KINDL, psychological health regression results. Plots are shown for the mean



FIGURE 2. Photograph of typical living conditions in the lower Inn valley in Austria

TABLE 1
Descriptive statistics and zero-order correlations

Variable	Mean	SD	1	2	3	4
1. Kindl	3.08	0.56		0.31*	0.91**	0.90**
2. Needleman	19.60	2.54			0.32*	0.24*
3. Functional impairment	3.05	0.63			0.64**	
4. Emotional well being	3.11	0.60				

* $p < 0.01$.
** $p < 0.001$.

TABLE 2
Mean density levels (people/room) in relation to maternal education and house type

	House type		
	Detached	Row house	Multiple dwelling
Mother education			
Basic (9 years)	0.89	0.86	1.04
Technical/trade	0.78	0.79	0.90
University prep.	0.76	0.80	0.86
University/graduate	0.79	0.85	0.86

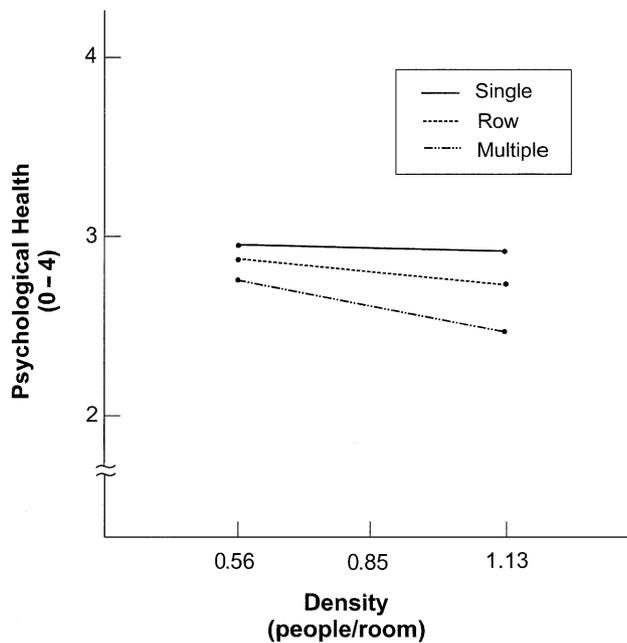


FIGURE 3. Regression of residential density onto children's self-reported mental health as a function of housing type

level of density and one standard deviation above and below the mean for each of the three categories of housing, single-family detached, row houses, mul-

multiple unit dwellings. Housing type is a categorical variable and density continuous. The regression analyses employ dummy coding for the categorical term (Fisher & van Belle, 1993). As can be seen, the relation between density and psychological health is moderated by house type, $F(2, 1148) = 3.31, p < 0.05$. For the interaction term, the increment in R^2 after partialling out mother's education and both of the main effects for house type and density is 0.01. Tests of the simple slopes indicate that for single family houses, density is unrelated to the KINDL, $b = -0.06, t(1148) = 1.27$ whereas for both row houses ($b = -0.20, t(1148) = 2.09, p < 0.05$) and for multiple dwelling units ($b = -0.36, t(1148) = 3.07, p < 0.01$) more household crowding is associated with diminished psychological health. There are also main effects for density, $\Delta R^2 = 0.05, F(1, 1152) = 12.66, p < 0.01$. Children living in more crowded homes report lower levels of psychological well being. There is also a main effect for house type, $\Delta R^2 = 0.02, F(2, 1151) = 3.47, p < 0.05$. Post hoc comparisons reveal that children living in multiple family dwellings and row houses report lower levels of psychological well being than those residing in single-family detached homes. Because of the natural covariation of density and maternal education ($r = -0.14$), all analyses statistically control for mother's education.¹ Housing type is unrelated to mother's education ($\chi^2 < 1.0$). We also examined whether mother's occupational status was related to either density or house type and found no systematic relations. For example whereas 14% of mothers in multiple dwelling units are unskilled workers compared to 10% and 6% for row houses and detached homes, respectively, 24% of mothers in multiple dwelling units are white collar compared to 20% each for row houses and detached homes. The largest category, homemaker, indicated 45% in multiple dwelling units, 55% in row houses, and 52% in detached homes. A similar, uninterpretable pattern of data were indicated for density and mother's occupational status. For example, homemakers average density is 0.60, unskilled laborers 0.52, and white collar 0.77. Exclusion of mother's education as a statistical control had little effect on the results reported herein.

As shown in Figure 4, similar interaction results were uncovered for the teacher ratings of behavioral disturbance in the classroom, $F(2, 1093) = 3.33, p < 0.05, \Delta R^2 = 0.01$. In this case, however, household crowding is correlated with behavioral disturbance only among those living in multiple-family dwellings, $b = -1.54, t(1093) = 2.89, p < 0.01$. Children in single family homes, $b = -0.11, t(1093) < 1.0$ and in

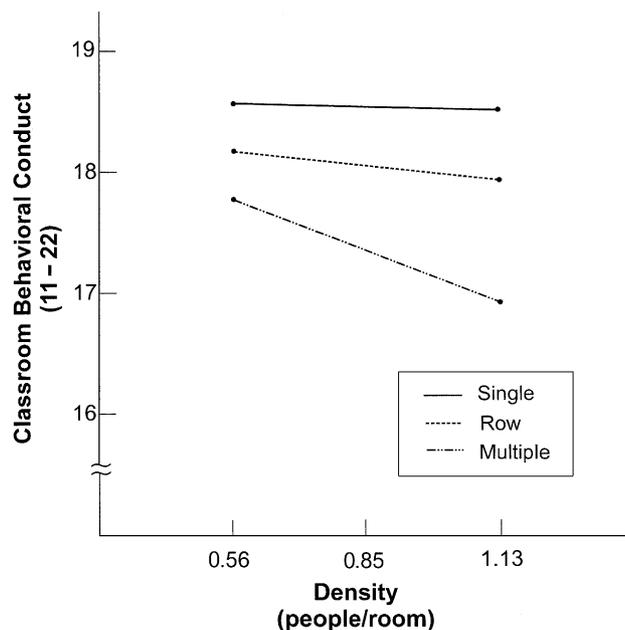


FIGURE 4. Regression of residential density onto teacher reports of behavioral conduct in the classroom as a function of housing type

row houses, $b = -0.63$, $t(1093) = 1.35$, ns., do not manifest links between crowding and behavioral disturbances at school. Again there are main effects for density, $F(1, 1097) = 5.16$, $p < 0.05$, $\Delta R^2 = 0.03$ as well as for house type, $F(2, 1096) = 3.96$, $p < 0.05$, $\Delta R^2 = 0.01$. Children from more crowded homes have greater levels of behavioral disturbance at school. Children living in multiple-family dwellings manifest greater behavioral disturbances at school than those living either in single family or row houses. As for the KINDL, all analyses statistically control for mother's education.

Discussion

The data in Table 1 provide some evidence for concurrent validity of the two indexes of children's psychological well being, given the correlation of 0.31 between the Needleman scale which is a teacher rating scale of conduct disorder and the child's self-report (KINDL) of emotional well being and functional impairment. Ideally, one would prefer a higher degree of convergent validation, although the level of correlation is well in line with expert ratings and middle elementary school children's self-reports of psychological health (Wachs, 1989). Our degree of convergent validity also compares well to that obtained by the original authors of the KINDL with other general assessments of children's mental

health (see discussion above in the Methods section). It is also worth brief mention that the Needleman teacher rating scale correlates at a higher level with the Functional Impairment subscale of the KINDL than it does with the Emotional Well Being subscale. Inspection of the items (see Appendix 1) indicates more content overlap between the Needleman scale and the Functional Impairment subscale relative to the Emotional Well Being subscale.

The primary objective of this study was to examine the interaction between house type and density as they inter-related to children's mental health. As indicated in Figures 1 and 2, the relations between residential density and psychological well being are moderated by housing type. Children who live in multiple-family dwellings react more strongly to high-density conditions than those living in either single-family or row houses. These results are independent of maternal educational levels and mother's occupational status is unrelated to house type or density. The findings for the child's self-reported mental well being data indicate that high density in row houses may also be harmful. The teacher ratings, however, reveal a relation between density and distress only for children living among multiple dwelling units.

The interaction of housing type and density on children's mental health adds to the small literature on environmental design and crowding. Psychologists studying density have tended to focus on what direct effects density has on human behavior as well as on individual differences (e.g. gender, culture) in response to crowding (Baum & Paulus, 1987; Evans, 2001). It is important for environmental psychologists to remember that design variables, similar to person variables, can function as moderators of psychosocial processes. The role of design not only as a direct precipitant of behavior but also as a factor that can alter how the human-environment system works has not been sufficiently developed. Design can help people cope with certain undesirable psychosocial conditions or it can exacerbate their harmful impacts. The present data along with previous research led to the prediction that high-density living will be better tolerated when children live in smaller dwellings, preferably detached units; when they have a room of their own or at least a designated playspace where they can be alone (Wachs & Gruen, 1982); when their residence is designed in such a way as to minimize uncontrollable social interactions (Baum & Valins, 1977, 1979); and when floorplans layouts provide better separation of rooms from one another (Evans *et al.*, 1996).

An interesting question raised by the data is at what level of density do psychological problems begin to emerge. Unfortunately, neither of the mental health scales contain cut points that would enable a more straightforward answer to this question. One alternative way to approach this question is by examining the regression equations for each of the outcome variables. In the case of the child's self-reported mental health (KINDL), for each increment in residential size of one room, mental health would be expected to improve 0.14 on a 0–4 scale across the entire sample. For the Needleman teacher ratings of behavioral problems at school, we would expect to see an improvement of 0.40 on a 11–22 scale. These expected improvements are based on the overall sample. If we look only at children residing in multiple dwelling units, much larger gains are apparent, 0.36 on the KINDL and 1.54 on the Needleman. These results also speak to the question of the potential practical significance of small effect sizes. Although the R^2 for the respective results as shown above are small for the interaction term and for house type and medium for the density main effect (Cohen, 1988), when considered in terms of changes in well being over a range of density for the different housing types, the degree of change in the outcome variables is meaningful, particularly for multiple dwelling inhabitants.

In thinking about the implications of the present data for theory and policy it is important to keep in mind that the extent of residential crowding, although from a large, representative sample, is not very severe. Since truncated variance in the predictor variable reduces estimation of covariance in the general linear model, the present results are likely conservative (Ghiselli *et al.*, 1981). Eighty-seven percent of the sample (1101) live in homes less than or equal to one person per room, not counting bath rooms. The U.S. Census Bureau designates residences greater than one person per room as crowded. Of the remaining 13% living in more crowded homes, 12% live at two persons per room or less. Thus within a somewhat restricted range of density, residential crowding particularly in multiple dwelling units, may be inimical to children's psychological well being. Of course, whether the results are actually conservative can only be discerned by replication in other samples where the range of density is greater. Since no other studies on children's self-reported mental health and crowding are available, we cannot speak directly to this specific finding. For teacher report of behavioral problems in the classroom, data with other teacher rating scales from studies at comparable, but low densities in

Canada (Booth & Johnson, 1975) and somewhat higher densities in the U.S. (Saegert, 1982) reveal similar levels of association between residential crowding and behavioral conduct in the classroom. A similar rating scale in India, where the range of density is much greater, revealed a larger association between household density and problematic classroom behaviors (Evans *et al.*, 1998).

It is important to keep in mind that the design of the present study precludes drawing causal conclusions. What we have shown in a cross-sectional design, is that there are associations between two physical variables, density and house type, and two different indices of children's well being. What is new and unique to the present study, is the finding that the relation of each of these environmental variables with psychological health is moderated by the other. As in prior studies, high-density and multiple dwelling housing, respectively, appear to be bad for young children. We present novel data indicating that the combination of these two environmental variables may be especially pathogenic. The other important new finding is the dose-response data on household density and mental health. These data allow estimates of threshold effects for density and strengthen empirical evidence for a density-related health impact.

Theoretically, we derived our density by dwelling-type interaction hypothesis on the grounds that density is believed to be harmful because of the surfeit of unwanted and uncontrollable social interactions that crowded inhabitants must deal with (Altman, 1975; Baum & Valins, 1977, 1979; Mc Carthy & Saegert, 1979; Saegert, 1982). Housing researchers also believe that one of the reasons why high-rise, multiple dwelling units are related to psychological distress in young children is because of social overload inside the unit created by restricted access to play areas outside of the residence (Halpern, 1995; Evans *et al.*, in press; Gifford, in press). Because the present study was designed as an epidemiological investigation of environmental quality and children's health, unfortunately no data were collected on potential psychosocial explanatory mechanisms. A priority for future research would be to determine if the interaction we have uncovered can be accounted for by social overload.

The housing literature assumes that high-rise living units in particular are troublesome to young children. In addition to information on the type of house, we also know which floor each dwelling is located on in our sample. When we examined this variable, type of housing unit, not floor level, was important both in terms of main effects and the

interaction results. However, examination of the floor level data revealed that 99.5% of the sample resided on the fourth floor or lower, thus precluding an adequate test of the implications of floor level for children's mental health. Although there is a paucity of data on this topic, the housing literature suggests that living above the fourth or fifth floor appears to be where difficulties emerge (Halpern, 1995; Evans *et al.*, in press; Gifford, in press). Thus another important extension of this study would be to stratify a future sample by floor level in order to insure that enough people living at higher floors were included in order to tease apart floor level effects from multiple dwelling categorization in general.

In addition to the interaction findings, the present data are also of some importance for examining the main effects of density and housing type, respectively, on children's mental health. What they reveal in the former case is that independent of mother's educational level, as density increases, modest decrements in children's psychological health occur. This finding extends prior research showing that residential density is associated with family conflict (Booth & Edwards, 1976; Saegert, 1982; Evans *et al.*, 1998) and diminished parental responsiveness to children (Bradley & Caldwell, 1984; Wachs, 1989; Evans *et al.*, in press). Thus, not only do family dynamics appear to shift in more crowded homes, these changes may play a role in children's mental health as indicated by children themselves on a well developed, standardized instrument. We also replicate three previous studies showing a link between residential density and teachers' ratings of behavioral conduct in the classroom (Booth & Johnson, 1975; Saegert, 1982; Evans *et al.*, 1998). We show that the latter relation generalizes to a much larger sample of children and holds in rural Austria. The Booth and Johnson and Saegert studies examined a wider range of ages; all three prior studies were conducted in urban areas, and Evans data are from India, Saegert's from public housing in New York city, and Booth and Johnson's from Canada. Thus, the link between density and teacher ratings of conduct in the classroom appears robust. Clearly more research, particularly with stronger longitudinal designs is necessary to bolster our confidence in the link between household crowding and children's mental health.

With respect to housing type, both measures show that multiple-family dwellings, independent of maternal educational background, are associated with poorer mental health in children. Post hoc tests for both the KINDL and the Needleman scale indicated no differences between single-family de-

tached housing and row housing. These findings replicate previous housing literature (Ineichen & Hooper, 1974; Richman, 1977; Saegert, 1982), demonstrating differences in children's mental health between multiple dwelling units and single-family homes. The findings further strengthen this literature in two respects. First, none of the prior studies used both self-report and adult ratings of mental health. Second, the prior studies focused on younger children, and two of them were conducted in other countries. Thus our parallel findings across two indices and with older children in the U.S. suggests the link between multiple housing occupancy and psychological distress may be broadly applicable to children. Another aspect of our data on housing type and mental health is notable. The housing literature finds that high rises in particular are problematic rather than multiple dwelling complexes per se. In the present sample, multiple dwelling units, even at four floors or less, differ from single-family detached and row houses, raising the question of whether the important design variable is floor level as the housing and mental health literature has suggested. Since prior studies of floor level confound building scale with height, this issue warrants further investigation. Clearly, it would also be valuable to study crowding, housing features and children's mental health with a stronger research design, ideally incorporating random assignment to housing conditions or, more realistically, prospective longitudinal designs. Currently, the little data available on children's mental health in relation to either residential density or housing quality emanate from cross-sectional studies.

The role of the physical environment, including house type in altering human-environment relations has not received adequate attention. Just as personal (e.g. temperament) or social (e.g. social support) resources can alter the fit between people and their surroundings, so too can the physical environment serve as a moderator that can exacerbate or buffer human responses to the environment (Becker, 1990; Evans & Lepore, 1997). Herein we demonstrate that the mental health sequelae of residential crowding among children are changed by the type of housing they inhabit. The harmful psychological correlates of density among elementary school children are accentuated by residing in multiple dwelling units. This interaction manifests in both children's self-reports and in independent teacher ratings of behavioral problems in the classroom.

We speculate that multiple dwelling units make it more difficult for children and their families to

regulate social interaction. This variable in combination with higher internal density leads to social withdrawal which, in turn, causes poor mental health. The taller and larger a multiple dwelling complex, the greater the adverse, symbiotic relations with residential crowding. Scientific validation of these ideas awaits further investigation.

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Notes

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1—Education is the most commonly used index of social class in epidemiological and social science research in Austria (*cf.* Lercher & Schmitzberger, 1997). It is not appropriate to inquire about family income in Austrian society. For example, no questions about income are included in the Austrian census. In addition to custom with respect to financial privacy, many Austrian mothers are working at home as housemothers (greater than half of the current sample). Furthermore, many families are single-parent heads of households or include cohabitating but unmarried adults. Moreover, Austrian families often provide some financial support for their children, especially when the children first move out of the parental residence and begin their own families. Data on father's are not included herein because of the large proportion of single parent or cohabitating households in Austria. The relations among maternal education, density and house type are shown above in Table 2. As indicated in the text, mother's occupational level is unrelated to house type or density. We included a statistical control for maternal education since it is correlated to density.

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Appendix¹

Measures of children's psychological well being

KINDL: Functional capacity in everyday life
During the last week...

It was easy for me to do my homework
I had difficulty concentrating
I had problems with my teachers
I was nervous and fidgety
I was proud of my achievements
Everything I started worked out
Everything got on my nerves

KINDL: Psychological well being
During the last week...

I felt grumpy and moody
I felt 'stressed out'

I was worn out and tired
I did not feel like doing anything
I had trouble at home
I had a lot of good ideas
Everything got too much for me to handle
I was cheerful and in a good mood
I felt frightened or insecure
I felt alone and deserted
I was upset because some things went wrong.

Needleman Teacher Behavior Rating Scale

Yes or no?

Is this child easily distracted during his/her work?

Can he/she persist with a task for a reasonable amount of time?

Can this child work independently and complete assigned tasks with minimal assistance?

Is his/her approach to tasks disorganized?

Do you consider this child hyperactive?

Is he/she over excitable and impulsive?

Is he/she easily frustrated by difficulties?

Is he/she a daydreamer?

Can he/she follow simple directions?

In general, is this child functioning as well in the classroom as other children his/her own age?