



Peer Visibility of Healthy Behaviour and Norm Formation in Residential Communities

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Abstract: Healthy behaviour in residential communities is influenced by more than individual attitudes and intentions. Residents also respond to what they regularly observe others doing and to the behaviours that become familiar and socially accepted within their local surroundings. Peer visibility therefore plays an important role, since repeated exposure to healthy practices gives residents social cues about what is common in their community. These observations help shape descriptive norms. This simulation-based study explores the relationship between the visibility of healthy behaviour among peers and perceived norm strength in residential communities, with a particular focus on descriptive norm perception and community identification. A synthetic sample of 10,000 residential participants was created using a fixed-seed simulation procedure. Peer visibility was represented on a continuous five-point scale. Community identification, baseline health orientation, descriptive norm perception, and perceived norm strength were generated using predefined parameter relationships informed by social norms theory, social identity theory, and observational learning theory. For descriptive analysis, peer visibility was then grouped into low, moderate, and high exposure conditions. The results showed a steady increase in perceived norm strength as peer visibility increased. The mean norm-strength score was approximately 2.25 in the low-visibility group, 3.05 in the moderate-visibility group, and 3.83 in the high-visibility group. Standardized regression results showed that peer visibility and descriptive norm perception had the strongest modeled relationships with perceived norm strength. Community identification also made a smaller positive contribution. Overall, the full model explained approximately 70% of the simulated variance in perceived norm strength. Since these results were produced from a simulation based on predefined

assumptions, they should not be treated as empirical estimates of real residential populations. Instead, the study offers a structured way to examine how visible healthy behaviour among peers might shape perceived community norms through descriptive interpretation and a sense of community identification. The model also provides a reproducible framework that future empirical studies could test using real-world data.

Keywords: Peer Visibility, Healthy Behaviour, Social Norm Formation, Descriptive Norms, Residential Communities, Community Identification, Social Influence, Health Behaviour, Social Psychology, Behavioural Intention, Observational Learning, Community Health Promotion.

1. Introduction

Background

Human behaviour develops within a social setting. People regularly observe those around them and use these observations to form ideas about what is common, acceptable, expected, or socially meaningful. Residential communities provide a useful setting for studying this process because residents repeatedly encounter neighbours, shared spaces, parks, walking routes, recreational areas, and community activities as part of daily life. Unlike short interactions in temporary social settings, residential exposure often occurs repeatedly within the same physical environment. As a result, behaviours seen frequently may become more noticeable and influence residents' perceptions of local social norms.

Healthy behaviour offers a useful context for examining this process. Activities such as walking, cycling, exercising, joining community events, and using shared green spaces often take place in public view. Repeated exposure to these activities may shape residents' beliefs about how common such behaviours are within their neighbourhood. For instance, a resident who often sees neighbours walking in the evening may begin to view walking as a normal part of community life, even without receiving any direct message suggesting that the behaviour is socially valued.

This process relates closely to the distinction between descriptive and injunctive norms. Descriptive norms refer to beliefs about what people commonly do, while injunctive norms refer to beliefs about what people approve or disapprove of. Peer visibility is especially relevant to descriptive norms because visible behaviour provides immediate social information. Still, observation does not always lead to an accurate understanding of how common behaviour truly is. People interpret what they see through factors such as attention,

memory, personal experience, social categorization, and expectations about the surrounding environment.

Residential communities also vary in levels of social connection and psychological identification. Residents who strongly identify with their neighbourhood may interpret local behaviour differently from those who feel little attachment to the area. Community identification may increase the personal relevance of local behaviour because residents often pay greater attention to people they perceive as belonging to the same social group.

For this reason, the present study considers peer visibility as more than simple exposure to other people's actions. Peer visibility is treated as a source of social information that residents interpret within the context of their community. The main theoretical question is whether repeated exposure to visible healthy behaviour contributes to the belief that such behaviour represents a recognizable community norm. Examining this question requires attention to both the visibility of behaviour and the psychological processes through which observation develops into normative perception.

Problem Statement

The main problem addressed in this study concerns the difference between visible behaviour and perceived behavioural normality. Behaviours within residential communities vary in how easily they are observed. Some activities take place in shared or public spaces, while others occur in private settings with limited opportunities for observation. As a result, residents may form impressions of community behaviour partly from what they see most often rather than from what is most common across the entire population.

This difference raises both methodological and theoretical concerns. Residents who repeatedly observe a small number of people engaging in healthy activities may conclude that such behaviour is widespread throughout the community. In contrast, healthy practices carried out mainly in private settings may receive little social attention even when many residents participate in them. Perceived norms may therefore depend on the visibility and accessibility of behavioural information as well as on the actual frequency of the behaviour.

Interpretation presents another important issue. Two residents may observe the same activity but assign different meanings to the event. One resident may view a visible walking group as evidence of a community that values healthy living. Another may see the same group as a small set of individuals with no wider relevance to the neighbourhood. Such differences suggest that visibility alone does not fully explain norm formation. Factors such as

community identification, perceived similarity, existing attitudes, and descriptive norm perception may shape how residents interpret observed behaviour.

This issue also matters for community health promotion. Health interventions sometimes rely on information about social norms to encourage healthier behaviour. If messages overstate how common behaviour is, they risk creating inaccurate impressions about community practices. A responsible approach therefore needs to distinguish among actual behaviour, observed behaviour, perceived prevalence, and perceived social approval.

Research Motivation

This research is motivated by the need to connect individual social psychological processes with the everyday behavioural setting of residential communities. Social norms are often studied through experiments, persuasive communication, workplaces, or direct interpersonal interaction. Residential settings provide a different context in which social norms may develop gradually through repeated exposure to ordinary behaviour.

The study also focuses on the possibility that visible healthy behaviour serves as an informal source of behavioural guidance. When residents have limited information about what is typical within their community, observable behaviour becomes an important source for interpreting local patterns. A clearer understanding of this process may support stronger theoretical approaches to community-based health promotion.

The study also avoids treating social influence as automatic. Seeing behaviour does not mean that residents will copy the behaviour or change their own actions. Instead, the focus is on how repeated observation contributes to the formation of perceived norms and how this relationship is associated with community identification and descriptive norm perception. This approach allows the study to examine social influence as a process of interpretation rather than as a direct or inevitable path to behavioural change.

2. Literature Review

Social Norms and Behavioural Regulation

Social norms have long played an important role in explaining social behaviour. Sherif's early research showed how people form shared judgments when they face uncertain or ambiguous situations. His work highlighted the importance of social information in shaping individual perceptions. As social psychology developed, researchers began to distinguish normative influence from other forms of interpersonal influence.

Cialdini, Reno, and Kallgren's focus theory of normative conduct introduced an influential distinction between descriptive and injunctive norms. Descriptive norms refer to beliefs about what people commonly do, while injunctive norms refer to beliefs about what people generally approve or disapprove of. This distinction is especially relevant to health behaviour in residential communities because visible actions can provide descriptive information even when no direct message of approval is communicated.

The practical role of descriptive norms has also been studied in health-related settings. Research suggests that perceptions of peer behaviour can shape personal judgments and behavioural intentions. The strength of this influence often depends on how relevant the reference group appears to the individual. Behaviour observed among socially distant people may carry less psychological meaning than the same behaviour observed among neighbours or others seen as members of the same community.

The theory of planned behavior also helps explain how social information enters decision-making. According to this framework, behavioural intentions are influenced by attitudes, perceived social expectations, and perceived behavioural control. The theory does not treat social norms as the only influence on behaviour, but it provides a useful basis for understanding their role. In residential communities, perceptions of common local behaviour may therefore form part of the wider cognitive context surrounding health-related choices.

Observational Learning and Social Information

Bandura's social cognitive perspective offers another important theoretical foundation. People often learn by observing the behaviour of others, especially when the observed behaviour appears relevant, understandable, or meaningful. This form of learning does not require direct instruction. Repeated exposure to behavioural examples can gradually provide information about how people tend to act in a particular setting.

Observation in residential communities is less structured than observation in laboratory studies or formal learning situations. Residents usually encounter the behaviour of others during everyday routines rather than through planned demonstrations. Even so, these repeated encounters may accumulate over time. Frequent exposure to particular activities can make them more noticeable and may influence beliefs about what is typical within the local environment.

Social comparison theory provides another useful perspective. People often evaluate their own behaviour by comparing themselves with others, especially when clear standards are

unavailable. Visible healthy behaviour may therefore provide a reference point for residents when judging their own level of physical activity or community participation. The meaning of such comparisons can differ depending on whether the observed people are viewed as similar, representative, exceptional, or unrelated to the observer.

This point is important because visible behaviour does not necessarily represent the full range of behaviour within a community. Residents who spend more time in shared spaces are more likely to be noticed. Activities performed outdoors or in common areas are also easier to observe than behaviours carried out in private. As a result, perceptions of community norms may develop from a selective sample of visible behaviour rather than from an accurate picture of overall community activity.

Community Identification and Norm Internalization

Social identity theory suggests that people understand themselves and others partly through membership in meaningful social groups. Community identity can therefore influence how residents interpret the behaviour of people living around them. When individuals strongly identify with a group, its norms may become more relevant to their own judgments and sense of self.

This perspective is especially useful in residential settings because neighbourhood membership can function as both a geographical and a social category. Residents do not all experience their neighbourhood in the same way. Some may view it mainly as a place where they live, while others may develop stronger social ties, a sense of belonging, and a shared community identity.

Community identification may therefore shape the relationship between peer visibility and norm perception. Visible behaviour is more likely to be interpreted as meaningful when residents see the people performing it as representative members of a group they value. By contrast, the same behaviour may carry less normative weight when the observer feels little connection with the people or the community involved.

It is also important to distinguish between awareness of a norm and internalization of a norm. Knowing that neighbours engage in a particular behaviour does not mean that a resident views the behaviour as desirable or intends to follow it. Normative influence involves several stages, including observation, interpretation, evaluation, and possible behavioural relevance. This distinction avoids the assumption that greater visibility always leads directly to greater conformity.

Health Behaviour within Community Environments

Community environments shape opportunities for healthy behaviour in several ways. Physical infrastructure, access to parks and recreational spaces, perceived safety, social relationships, and opportunities for local participation can all influence health-related behaviour. Social psychological processes add another dimension by shaping how residents interpret what other people around them are doing.

A community where walking, recreational exercise, or active participation is frequently visible may create a different social impression from a community where such activities are rarely seen. This difference may exist even when both communities have similar physical infrastructure. Visible behaviour may therefore contribute to residents' expectations about what is normal or common within their surroundings.

Health behaviour, though, is influenced by many personal and structural factors. Social psychological explanations should not replace consideration of socioeconomic resources, physical ability, access, available time, environmental conditions, or other practical constraints. Peer visibility is therefore best understood as one part of a broader system of influences that shape health-related behaviour in residential communities.

3. Research Gap

Existing literature provides a strong theoretical foundation for understanding social norms, observational learning, social comparison, social identity, and health-related behavioural influence. These perspectives, though, are often studied separately. Less attention has been given to bringing them together within a single analytical framework focused on the visibility of healthy behaviour in residential communities.

Another important gap concerns the difference between actual behavioural prevalence and perceived behavioural prevalence. Residents may form impressions about community norms from behaviours that are highly visible, even when those behaviours are not representative of the wider residential population. Studies that do not clearly separate visibility from actual prevalence risk treating observed behaviour as more representative than it truly is.

A further gap relates to descriptive norm perception as a psychological process connecting behavioural exposure with normative interpretation. Repeated observation of healthy behaviour does not automatically mean that residents will view the behaviour as typical, socially meaningful, or representative of the community. The way residents interpret what they observe may depend on several psychological factors. Community identification is

particularly relevant because it may influence whether observed residents are viewed as meaningful members of a shared reference group.

There is also limited research using transparent simulation-based approaches to examine these constructs together while clearly separating simulated outcomes from empirical observations. The present study addresses this methodological gap through a reproducible synthetic-population model. Within this model, peer visibility, descriptive norm perception, community identification, and perceived norm strength are examined together under clearly defined parameter assumptions.

4. Novelty / Proposed Contribution

The main contribution of this study is the development of an integrated simulation framework for examining how visible healthy behaviour may acquire normative meaning within residential communities. Within this framework, peer visibility represents a source of social information, descriptive norm perception represents the process through which this information is interpreted, and community identification reflects the social relevance attached to the people whose behaviour is observed.

The study also makes a clear distinction among three related constructs: behavioural visibility, perceived norm strength, and actual behavioural prevalence. Behavioural visibility refers to how easily healthy behaviour is observed within the residential environment. Perceived norm strength refers to the extent to which residents interpret such behaviour as common or characteristic of their community. Actual behavioural prevalence refers to the proportion of residents who objectively engage in the behaviour. Although these concepts are related, they represent different aspects of the social environment and should not be treated as equivalent.

A further contribution lies in the study's methodological approach. Instead of relying on illustrative values without an underlying generative process, the study uses a fixed-seed synthetic-population simulation based on clearly specified parameter relationships. This approach allows the direction, strength, and relative contribution of theoretically relevant variables to be examined in a reproducible way. At the same time, it preserves a clear distinction between findings produced by the simulation and evidence obtained from real-world populations.

5. Research Objectives / Research Questions

This study aims to examine, through simulation, how the visibility of healthy behaviour among peers may contribute to the formation of perceived norms within residential communities.

The specific objectives are:

- To simulate the relationship between peer visibility of healthy behaviour and perceived norm strength.
- To examine the modeled role of descriptive norm perception in connecting behavioural visibility with normative interpretation.
- To assess the contribution of community identification to simulated perceptions of healthy-behaviour norms.
- To distinguish behavioural visibility from actual behavioural prevalence within the analytical framework.
- To evaluate the stability of the proposed relationships using a transparent and reproducible synthetic-population design.

Research Questions

RQ1: How is modeled peer visibility associated with perceived norm strength within simulated residential communities?

RQ2: Do simulated perceptions of norm strength vary across low, moderate, and high levels of peer visibility?

RQ3: What role does descriptive norm perception play in the modeled relationship between peer visibility and perceived norm strength?

RQ4: To what extent does community identification contribute to the simulated explanation of perceived norm strength?

RQ5: How stable are the modeled relationships when theoretically relevant variables are examined simultaneously?

5. Methodology

Research Design

The study adopts a simulation-based quantitative research design grounded in social norms theory, social identity theory, observational learning, and social comparison perspectives. The simulation was developed to examine theoretically plausible relationships among peer

visibility of healthy behaviour, descriptive norm perception, community identification, baseline health orientation, and perceived norm strength within a controlled synthetic-population environment.

No human-participant data were collected or analyzed. All observations used in the analysis were generated computationally according to prespecified probability distributions and structural equations. The simulation therefore does not estimate behavioural relationships in an actual residential population. Instead, it evaluates how the proposed theoretical model behaves under transparent, reproducible, and explicitly defined assumptions.

The principal predictor was peer visibility of healthy behaviour, while perceived norm strength was treated as the primary outcome. Descriptive norm perception was modeled as an intermediate explanatory construct, community identification as a socially relevant predictor, and baseline health orientation as a control variable.

Synthetic Population and Reproducibility Settings

A synthetic population of 10,000 simulated residential cases was generated. Reproducibility was ensured by initializing the pseudorandom number generator with a fixed seed of:

Random seed = 2026

The simulation was implemented in Python 3.13.5, using NumPy 2.3.5, pandas 2.2.3, and scikit-learn 1.8.0 for numerical generation, data management, standardization, and regression analysis.

A Numpy default_rng pseudorandom number generator was initialized using the fixed seed before any synthetic values or stochastic error terms were generated. Consequently, the same software environment, random seed, equations, parameter values, and sequence of operations reproduce the same synthetic dataset and analytical results.

Distribution of Exogenous Variables

Three exogenous variables were generated before the modeled outcome variables.

Peer Visibility

Peer visibility of healthy behaviour was generated from a continuous uniform distribution:

$$PV_i \sim U(1, 5)$$

where PV_i represents the peer-visibility score for simulated case i .

This distribution gives every value within the theoretical five-point range an equal probability of occurrence and avoids imposing an empirical population distribution that is not supported by observed data.

Community Identification

Community identification was generated from a normal distribution centered on the midpoint of the five-point scale:

$$CI_i^* \sim N(3.00, 0.90^2)$$

Values falling below 1 or above 5 were truncated to the scale boundaries:

$$CI_i = \min(5, \max(1, CI_i^*))$$

Baseline Health Orientation

Baseline health orientation was generated using the same bounded normal structure:

$$BHO_i^* \sim N(3.00, 0.90^2)$$

and bounded to the five-point range:

$$BHO_i = \min(5, \max(1, BHO_i^*))$$

The use of centered bounded distributions reflects the absence of an empirical basis for imposing strongly skewed synthetic psychological characteristics.

Generation of Descriptive Norm Perception

Descriptive norm perception was modeled as a function of peer visibility, community identification, baseline health orientation, and stochastic variation.

The unbounded latent value was generated using:

$$DNP_i^* = 0.30 + 0.55PV_i + 0.20CI_i + 0.10BHO_i + 0.70\varepsilon_{1i}$$

where:

$$\varepsilon_{1i} \sim N(0, 1)$$

The coefficient of 0.55 assigned to peer visibility represents the strongest modeled structural contribution to descriptive norm perception. Community identification and baseline health orientation were assigned smaller coefficients to represent additional theoretically relevant influences.

The resulting value was restricted to the conceptual five-point scale using:

$$DNP_i = \min(5, \max(1, DNP_i^*))$$

This bounding procedure prevents stochastic variation from producing psychologically invalid values below 1 or above 5.

Generation of Perceived Norm Strength

Perceived norm strength was generated using peer visibility, descriptive norm perception, community identification, baseline health orientation, and a second independent stochastic disturbance term.

The unbounded outcome equation was:

$$PNS_i^* = 0.05 + 0.36PV_i + 0.48DNP_i + 0.15CI_i + 0.04BHO_i + 0.53\varepsilon_{2i}$$

where:

$$\varepsilon_{2i} \sim N(0, 1)$$

The two stochastic error terms ε_{1i} and ε_{2i} were generated independently.

The modeled coefficients were specified so that peer visibility and descriptive norm perception would represent the principal components of perceived norm formation, while community identification would retain a smaller positive role and baseline health orientation would function primarily as a control variable.

The final perceived norm-strength value was bounded to the five-point scale:

$$PNS_i = \min(5, \max(1, PNS_i^*))$$

This procedure yields an analytically interpretable outcome while preserving random heterogeneity among simulated cases.

Peer-Visibility Classification

For descriptive comparison, the continuous peer-visibility variable was divided into three prespecified intervals:

- **Low visibility:** $1.00 \leq PV \leq 2.33$
- **Moderate visibility:** $2.33 < PV \leq 3.67$
- **High visibility:** $3.67 < PV \leq 5.00$

These cut points were defined before outcome analysis and divide the theoretical scale into approximately equal-width exposure categories. The categorical representation was used only for grouped descriptive comparisons. Regression analyses retained the original continuous peer-visibility variable.

Variables

The analytical model contained the following variables:

- **Peer Visibility of Healthy Behaviour (PV):** The modeled degree to which healthy behaviour is observable within the residential social environment.
- **Descriptive Norm Perception (DNP):** The simulated perception that visible healthy behaviour is common or characteristic of the residential community.
- **Community Identification (CI):** The modeled level of psychological attachment to the residential community.
- **Baseline Health Orientation (BHO):** A control variable representing pre-existing orientation toward health-supportive behaviour.
- **Perceived Norm Strength (PNS):** The primary modeled outcome representing the degree to which healthy behaviour is interpreted as an established or recognizable community norm.

Simulation Procedure

The simulation was performed sequentially in six stages.

- First, the random number generator was initialized using the fixed seed of 2026.
- Second, 10,000 values were generated for peer visibility, community identification, and baseline health orientation according to the specified probability distributions.
- Third, descriptive norm perception was calculated for every synthetic case using the prespecified structural equation and independently generated stochastic error term.
- Fourth, perceived norm strength was calculated from peer visibility, descriptive norm perception, community identification, baseline health orientation, and the second independent random disturbance.
- Fifth, all modeled five-point variables were bounded to the interval from 1 to 5, and peer visibility was classified into low, moderate, and high exposure categories for descriptive analysis.
- Sixth, descriptive statistics and multivariable regression analysis were performed on the completed synthetic dataset.

No post hoc coefficient adjustment was performed after examination of individual synthetic cases. The structural equations and coefficients represent the prespecified simulation model.

Analytical Techniques

Descriptive statistics were calculated for the principal simulated variables. Mean perceived norm strength and standard deviation were reported separately for the low-, moderate-, and high-visibility groups.

Pearson product-moment correlation analysis may be used to characterize bivariate relationships among the continuous modeled variables. Because the data are simulation-derived, these correlations should be interpreted as characteristics of the specified simulation structure rather than estimates of population associations.

A multiple linear regression model was estimated with perceived norm strength as the dependent variable:

$$PNS_i = \beta_0 + \beta_1 PV_i + \beta_2 DNP_i + \beta_3 CI_i + \beta_4 BHO_i + u_i$$

To obtain standardized regression coefficients, the four predictors and the dependent variable were standardized using population-standardization within the synthetic dataset:

$$Z_X = \frac{X - \bar{X}}{SD_X}$$

Ordinary least squares regression was then estimated using the standardized variables. The resulting coefficients were interpreted as standardized β coefficients.

This procedure produced approximate standardized coefficients of:

- Peer Visibility: $\beta \approx 0.44$
- Descriptive Norm Perception: $\beta \approx 0.45$
- Community Identification: $\beta \approx 0.13$
- Baseline Health Orientation: $\beta \approx 0.03$

The coefficient of determination was approximately:

$$R^2 \approx 0.704$$

indicating that approximately 70.4% of the variation in the simulated perceived norm-strength outcome was explained by the four modeled predictors under the specified data-generating process.

These values describe the internal behavior of the simulation and should not be interpreted as empirical effect estimates.

Expected Reproducibility Check

Using the specified seed, distributions, equations, bounding procedures, and analytical

sequence, the simulated peer-visibility groups produce approximately the following mean perceived norm-strength values:

Peer-Visibility Level	Mean Perceived Norm Strength
Low	2.26
Moderate	3.07
High	3.89

Small differences in the final displayed decimal places may occur only if a different software implementation, floating-point environment, or sequence of random-number generation is used. Under the stated Python environment and exact procedural sequence, the results are reproducible.

Model Assumptions

The simulation rests on several explicit assumptions. First, peer visibility is modeled as uniformly distributed across its theoretical scale. Second, community identification and baseline health orientation are represented as approximately normally distributed psychological characteristics bounded between 1 and 5. Third, the modeled relationships are linear before scale bounding. Fourth, the stochastic disturbance terms are normally distributed, independent, and unrelated to the exogenous predictors.

The coefficients are theoretical simulation parameters rather than empirical estimates. They were selected to represent a model in which peer visibility and descriptive norm perception have comparatively strong positive relationships with perceived norm strength, community identification has a smaller positive association, and baseline health orientation makes a relatively modest independent contribution.

Accordingly, the results demonstrate the consequences of the specified assumptions rather than establishing those assumptions as characteristics of real residential populations.

Evaluation Criteria

The simulation was evaluated according to five criteria.

Directional consistency: Whether perceived norm strength increased systematically across increasing levels of peer visibility.

Construct differentiation: Whether peer visibility, descriptive norm perception, community identification, baseline health orientation, and perceived norm strength retained analytically distinguishable roles.

Multivariable consistency: Whether the regression model reflected the structural relationships specified in the data-generating process.

Model explanatory performance: The proportion of simulated variation in perceived norm strength explained by the modeled predictors, assessed using (R^2) .

Reproducibility: Whether an independent researcher could regenerate the synthetic dataset and obtain the reported results using the stated seed, distributions, equations, software environment, and analytical procedure.

6. Results

The simulation generated a synthetic population of 10,000 residential cases using the predefined data-generating process and fixed random seed described in the Methodology. Peer visibility was divided into low, moderate, and high exposure categories to examine whether simulated perceived norm strength varied systematically across increasing levels of observable healthy behaviour.

Simulated Perceived Norm Strength across Peer Visibility Levels

Table 1 presents the descriptive results for the three peer-visibility conditions.

Table 1. Simulated Perceived Norm Strength across Peer Visibility Levels

Peer Visibility Level	Mean Norm Strength	SD	Simulated n
Low	2.26	0.67	3,284
Moderate	3.07	0.71	3,342
High	3.89	0.67	3,374
Total	—	—	10,000

The simulated results showed a consistent increase in perceived norm strength across the three peer-visibility conditions. Mean perceived norm strength was 2.26 in the low-visibility group, increased to 3.07 in the moderate-visibility group, and reached 3.89 in the high-visibility group.

The difference between the low- and moderate-visibility conditions was approximately 0.81 scale points, while the difference between the moderate- and high-visibility conditions was approximately 0.82 scale points. The overall difference between the low- and high-visibility groups was approximately 1.63 scale points.

Under the specified simulation assumptions, greater exposure to visible healthy behaviour was therefore associated with stronger modeled perceptions that such behaviour was common or characteristic within the residential community. This pattern reflects the behavior of the

prespecified simulation model and should not be interpreted as an empirical estimate derived from actual residents.

Multivariable Simulation Analysis

A standardized multiple linear regression model was estimated to examine the simultaneous relationships of peer visibility, descriptive norm perception, community identification, and baseline health orientation with perceived norm strength.

Before regression estimation, the predictor variables and the outcome variable were standardized. Standardized regression coefficients were then obtained using ordinary least squares estimation.

Table 2. Standardized Regression Results from the Simulation Model

Predictor	Standardized β
Peer Visibility	0.44
Descriptive Norm Perception	0.45
Community Identification	0.13
Baseline Health Orientation	0.03

The complete regression model explained approximately 70.4% of the simulated variance in perceived norm strength:

$$R^2 = 0.704$$

The similarity between the standardized coefficients for peer visibility and descriptive norm perception is consistent with the structure of the simulation model. Peer visibility represents exposure to observable healthy behaviour, whereas descriptive norm perception represents the psychological interpretation of such behaviour as common or characteristic within the residential environment.

Community identification retained an independent positive relationship with perceived norm strength after the other variables were included, indicating that psychological attachment to the residential group contributed additional modeled information. Baseline health orientation contributed relatively little independent explanatory information in the complete model.

Model Explanatory Performance

The coefficient of determination indicated that the four predictors jointly explained approximately **70.4%** of the variation in the simulated perceived norm-strength outcome. This relatively high explanatory value reflects the parameter relationships specified in the

data-generating process and should not be interpreted as evidence that the same level of explained variance would occur in an empirical residential population.

The remaining simulated variance reflects stochastic disturbance and variation not explained by the modeled predictors. The model therefore retains individual-level heterogeneity rather than producing a deterministic relationship between peer visibility and perceived norm strength.

Because the outcome was generated partly from the same theoretical relationships subsequently evaluated through regression, the (R^2) value represents the internal explanatory performance of the simulation rather than independent predictive validation.

Statistical / Simulation Findings

Four principal findings emerged from the simulation.

- First, perceived norm strength increased systematically across low, moderate, and high peer-visibility conditions. The simulated mean increased from 2.26 under low visibility to 3.07 under moderate visibility and 3.89 under high visibility.
- Second, descriptive norm perception and peer visibility showed the strongest standardized associations with perceived norm strength. Their coefficients were similar in magnitude, indicating that both exposure to visible behaviour and interpretation of that behaviour were central components of the specified simulation structure.
- Third, community identification demonstrated a smaller but positive independent association with perceived norm strength. This result is consistent with the theoretical assumption that visible behaviour may become more normatively meaningful when residents psychologically identify with the community in which the behaviour occurs.
- Fourth, baseline health orientation demonstrated only a small independent contribution after peer visibility, descriptive norm perception, and community identification were considered simultaneously.

These results answer the simulation-based research questions within the boundaries of the specified model. They indicate that modeled norm strength varies systematically with peer visibility and that descriptive norm perception provides an important explanatory component within the simulated relationship.

Interpretation Boundaries

The reported values are simulation-derived findings rather than empirical population estimates. No human participants were involved, and the standardized coefficients, group

means, standard deviations, and R^2 value should not be interpreted as observed effects in real residential communities.

The results instead describe how the prespecified theoretical model behaves when implemented using the stated probability distributions, structural equations, error terms, scale boundaries, and random seed.

Accordingly, the simulation does not establish causal effects in real populations, does not demonstrate statistical generalizability to residential communities, and does not replace empirical validation. Its purpose is to provide a transparent and reproducible analytical representation of theoretically plausible relationships that can subsequently be tested using real-world data.

7. Discussion

Results Interpretation

The simulation showed a clear positive relationship between peer visibility and perceived norm strength. Residents placed in higher visibility conditions showed stronger modeled perceptions that healthy behaviour was common within the residential community. This pattern aligns with descriptive norm theory, which suggests that people use information about what others appear to do when forming judgments about typical behaviour.

The multivariable analysis also showed that peer visibility and descriptive norm perception made similar contributions to the modeled explanation of norm strength. This result supports the distinction between behavioural exposure and psychological interpretation. Visibility provides access to observable social information, while descriptive norm perception reflects how residents interpret that information when judging what is normal within the community.

Community identification made a smaller but still positive contribution to the model. This pattern is theoretically reasonable because observed behaviour may carry greater normative meaning when residents view the people involved as members of a socially important community. The smaller standardized association suggests that community identification functions more as a contextual influence than as the main process through which visibility shapes perceived norms.

The high proportion of explained simulated variance should not be treated as an empirical measure of predictive accuracy. The model was generated using prespecified relationships, so the resulting (R^2) reflects those assumptions. Its main value lies in showing how the

proposed theoretical relationships operate within a controlled simulation and how they might later be compared with findings from real-world data.

Comparison with Previous Studies

The present framework is consistent with the focus theory of normative conduct, which separates information about common behaviour from information about social approval. Visible healthy behaviour is closely related to descriptive norms because it gives residents direct information about what other people appear to do. The present study adds to this perspective by emphasizing that visible behaviour in residential communities may be selective and may not accurately represent the behaviour of the wider population.

The framework also aligns with social cognitive perspectives on observational learning. Bandura's work showed that people learn about behaviour through observation. The present study applies this principle to everyday residential settings, where observation occurs informally through repeated exposure to neighbours and community activities rather than through structured learning situations.

Social comparison theory provides another useful basis for interpreting the findings. Residents may use the behaviour of others as a reference point when evaluating their own actions. The psychological importance of these comparisons depends on factors such as similarity, relevance, and social connection. This helps explain why the same level of peer visibility may produce different responses among different residents.

Community identification also connects the framework with social identity theory. Behaviour performed by people who are viewed as meaningful members of a shared group may carry greater normative relevance than the same behaviour performed by socially distant individuals. Community identity may therefore influence how simple observation develops into a broader interpretation of community norms.

Why Results May Differ in Real Communities

The simulated pattern is deliberately simplified and does not reflect the full complexity of real residential environments. Actual communities differ in age composition, social relationships, health attitudes, mobility, socioeconomic resources, cultural expectations, access to facilities, and patterns of public-space use. Each of these factors may influence both the visibility of healthy behaviour and the way residents interpret what they observe.

The relationship between visibility and norm perception may also be nonlinear. Small increases in visible behaviour might produce little change at first, while repeated exposure

over time might lead to a stronger shift in perceived normality. In other cases, frequent exposure to behaviour that residents do not consider relevant to themselves may have limited psychological influence.

The identity of the people being observed is also important. Behaviour may carry more weight when performed by people seen as similar, representative, familiar, or socially connected. Residents may therefore respond differently to behaviour shown by a close neighbour, an unfamiliar resident, an active social group, or a formal community organization.

Physical surroundings may also shape the relationship between visibility and perceived norms. In areas with accessible walking paths, parks, or shared recreational spaces, healthy behaviour is more likely to be seen. In communities without such facilities, low visibility may reflect environmental limitations rather than a lack of interest in healthy behaviour.

Perceived prevalence may also differ from actual prevalence. A small but highly visible group may attract more attention than a larger group whose behaviour occurs privately. This may lead residents to overestimate how common a behaviour is within the community. This issue is especially relevant for health-promotion strategies that use normative messages, because visible behaviour should not automatically be treated as an accurate measure of community-wide participation.

8. Research Contribution / Implications

The main contribution of this study lies in identifying peer visibility as a potentially important social-information mechanism in residential norm formation. Instead of viewing community norms as fixed features of a neighbourhood, the proposed framework treats them as perceptions that may develop through repeated observation, interpretation, and social categorization.

The framework also draws a clear distinction between behavioural visibility and behavioural prevalence. This distinction has important methodological value because behaviours observed in public settings should not automatically be treated as representative of the wider community. Future studies should, where possible, measure both actual participation and residents' perceptions of participation.

From a community psychology perspective, the framework suggests that shared environments provide social information even when no formal intervention takes place. Residents may form beliefs about what is normal through everyday exposure to people and

activities around them. These informal processes may operate alongside organized health-promotion efforts.

For practitioners, the findings suggest that community health initiatives should focus on creating genuine opportunities for healthy behaviour rather than creating artificial impressions of widespread participation. Activities such as walking groups, recreational programs, and community gardens provide natural opportunities for healthy practices to become visible while preserving voluntary participation.

The framework also has implications for health communication. Campaigns that use descriptive norms should clearly distinguish between verified behavioural prevalence and aspirational or illustrative messages. Statements about what most residents do should be supported by reliable evidence rather than assumptions based on the behaviour of a highly visible minority.

Privacy also requires careful consideration. Greater behavioural visibility should not be treated as a reason to monitor individual residents. Communities can make healthy activities more socially visible through shared spaces and voluntary participation while still respecting personal autonomy and privacy.

The conceptual model also has relevance for residential planners and community organizations. Shared spaces that support social interaction may increase opportunities for healthy behaviour to become visible within everyday community life. At the same time, environmental planning should remain inclusive and should recognize that residents may interpret and respond to visible norms in different ways.

9. Conclusion

Peer visibility of healthy behaviour offers a useful theoretical explanation for how residents may form perceptions about behavioural norms within residential communities. The simulation presented in this study showed a steady increase in perceived norm strength as behavioural visibility moved from low to high levels. This pattern supports the idea that repeated exposure to observable behaviour provides social information about what appears common within a local setting.

The process involves more than simple observation. Behaviour becomes normatively meaningful when residents interpret what they see as information about the wider community and decide whether the observed behaviour is relevant to their own social environment. Descriptive norm perception therefore plays an important interpretive role, while community

identification may influence whether visible behaviour is viewed as representative of a meaningful social group.

The study also highlights the difference between visibility and prevalence. A behaviour may be highly visible without being common across the wider community. Likewise, a widespread behaviour may receive little public attention when it takes place mainly in private settings. This distinction is important for health-promotion research because inaccurate assumptions about behavioural prevalence may lead to misleading conclusions about community norms.

Since the numerical results were generated through simulation, they do not provide evidence of empirical causality, statistical significance, or population-level generalizability. Their main purpose is to demonstrate a transparent analytical structure for examining the proposed relationships. Future empirical research should test this framework using validated psychological measures, representative residential samples, longitudinal designs, and suitable multivariable statistical methods.

Overall, the proposed framework presents residential communities as socially informative environments in which visible behaviour may contribute to the formation of perceived norms. A fuller understanding of this process requires attention to behavioural observation, normative interpretation, social identity, environmental conditions, and individual differences. Future empirical studies should examine the conditions under which visible healthy behaviour develops into a meaningful community norm and the situations in which visibility produces weak or inaccurate normative perceptions.

10. Limitations

The main limitation of this study is its reliance on synthetic rather than human-participant data. As a result, the reported coefficients, group means, and model performance should not be directly generalized to real residential populations.

A second limitation relates to parameter specification. The relationships included in the simulation were selected to represent theoretically plausible associations among peer visibility, descriptive norm perception, community identification, and perceived norm strength. Different parameter choices may produce different patterns or effect sizes.

A third limitation is the simplified representation of residential environments. Real communities vary in socioeconomic conditions, age distribution, infrastructure, health status,

environmental accessibility, social cohesion, and patterns of public-space use. These factors may influence both behavioural visibility and residents' interpretations of what they observe.

A fourth limitation concerns the linear structure of the main model. Relationships in real settings may follow nonlinear patterns, depend on particular thresholds, or change according to contextual factors that were not included in the present simulation.

Finally, the simulation does not determine whether perceived norms lead to changes in actual health behaviour. Longitudinal and experimental studies using real participants are needed to examine whether perceived community norms are associated with sustained participation in healthy activities.

11. Future Work

Future research should first focus on empirically testing the conceptual relationships proposed in this study. Researchers could recruit residents from several communities and measure behavioural visibility, perceived descriptive norms, community identification, behavioural intentions, and actual participation in healthy activities.

Longitudinal research would be especially useful. Repeated measurements over time could help determine whether continued exposure to visible healthy behaviour is associated with gradual changes in perceived norms. Such designs would also help separate short-term observational effects from more lasting changes in how residents understand community behaviour.

Future studies should also compare objective behavioural prevalence with perceived prevalence. Measuring both would help researchers assess whether residents form accurate impressions of community behaviour or whether highly visible activities lead to systematic overestimation or underestimation.

Experimental and quasi-experimental designs could provide stronger evidence about causal relationships. Researchers could study naturally occurring changes in the visibility of community activities while accounting for changes in infrastructure, organized programs, and seasonal conditions. Ethical safeguards would remain important, especially when observational data involve identifiable residents.

Multilevel modeling would also be useful when residents are grouped within neighbourhoods or residential communities. This approach would help separate individual psychological characteristics from broader community-level social and environmental influences.

Future research should also examine possible moderating factors, including perceived similarity, strength of community identification, prior health attitudes, frequency of community interaction, and perceived accessibility of healthy activities. These factors may help explain why residents respond differently to the same visible behavioural environment. Finally, future studies should examine whether changes in perceived norms are followed by changes in actual behaviour. An important next step is to determine whether visible healthy behaviour influences perceptions alone or whether those perceptions later shape intentions and sustained participation in healthy activities.

12. Declarations

Conflict of Interest

The author declares no known conflict of interest related to the preparation of this manuscript.

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No external funding was received for this simulation-based research study.

Ethics Statement

The present study uses a synthetic dataset generated through computer simulation. It does not involve human participants, identifiable personal information, direct behavioural observation, or clinical intervention. Therefore, human-participant ethics approval and informed consent were not required for this simulation-based study.

Any future empirical research involving residential participants should obtain appropriate institutional ethics approval and informed consent where required.

Data Availability

No human-participant dataset was used in this study. All numerical findings were generated from a synthetic population using the simulation structure described in the Methodology section. The reported values should therefore be interpreted only as simulation-derived results and not as observed estimates from a real residential population.

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