



Shared Physical Challenges as Catalysts for Interpersonal Trust among Strangers

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Abstract: Interpersonal trust is fundamental to the formation of cooperative relationships, particularly when individuals interact without an established history of prior contact. Trust formation among strangers is inherently uncertain because individuals initially possess limited information about another person's intentions, reliability, responsiveness, and willingness to cooperate. Shared physical challenges provide a distinctive interpersonal context in which previously unacquainted individuals may need to coordinate actions, communicate under demanding conditions, adapt to one another's behavior, and depend on mutual effort to accomplish a common objective. The present Conceptual-Methodological Interpersonal Psychology Research Article develops an integrated framework for examining how shared physical challenges may contribute to the early formation of interpersonal trust among strangers. The framework draws on research concerning interpersonal trust, cooperative interdependence, behavioral synchrony, shared experience, social bonding, responsiveness, perceived reliability, and coordinated social interaction. Rather than assuming that physical challenge itself generates trust, the proposed framework emphasizes the interactional processes through which trust may emerge. Cooperative interdependence is positioned as a central mechanism because shared tasks can create situations in which participants must rely on one another's actions. Interpersonal responsiveness is also treated as an important source of behavioral information, as participants may evaluate whether a partner communicates effectively, adapts to changing circumstances, provides assistance, and responds appropriately to shared demands. Successful coordination may further reduce interpersonal uncertainty by providing direct evidence of dependability and by creating a common interaction history between previously unfamiliar individuals. The framework also

distinguishes interpersonal trust from related constructs such as social bonding, behavioral synchrony, social closeness, and general cooperation. Although these processes may contribute to positive interpersonal experiences, they should not be treated as equivalent to trust, which involves expectations concerning another person's future reliability and behavior under conditions of uncertainty. Challenge intensity, perceived fairness, communication quality, contribution balance, prior trust propensity, and the cooperative or competitive structure of the activity are identified as contextual factors that may strengthen, weaken, or alter the proposed relationship. No original human-participant data are reported in the present study. The contribution of the article is therefore conceptual and methodological rather than empirical. It provides a theoretically grounded structure for future validation through experimental, prospective, or longitudinal research involving stranger dyads. Future studies should combine validated self-report trust measures with behavioral indicators of cooperation, assess interaction quality and perceived responsiveness, and distinguish immediate post-activity responses from more persistent changes in interpersonal trust. The proposed framework offers a structured basis for investigating how shared physical experiences may provide behavioral evidence that supports, limits, or modifies the development of trust between strangers.

Keywords: Interpersonal Trust; Shared Physical Challenges; Strangers; Social Bonding; Cooperation; Interpersonal Interaction; Behavioral Synchrony; Shared Experience; Social Psychology; Trust Formation; Group Interaction; Reciprocal Dependence; Physical Activity; Relationship Formation; Social Connection.

1. Introduction

Background

Interpersonal trust is a central component of social relationships because individuals frequently need to cooperate with people whose intentions and future behavior cannot be known with certainty. Trust becomes particularly important when individuals encounter strangers because the absence of prior relational history limits the amount of information available about another person's reliability. Before meaningful interaction occurs, strangers must often make judgments based on limited behavioral cues, situational expectations, and immediate interaction experiences.

Trust is therefore not simply an internal attitude toward another individual. It can also be understood as a relational process that develops through interaction. When people cooperate successfully, fulfill expected responsibilities, respond appropriately to one another, and demonstrate reciprocal behavior, they acquire information that can influence subsequent expectations.

Research on trust building has examined how interpersonal exchanges create information about reliability. Ho and Weigelt investigated trust building among strangers using a multistage trust-game framework in which participants repeatedly interacted and could obtain social gains by trusting one another. Their work illustrates the importance of repeated exchange in the development of interpersonal trust.

Shared physical challenges offer an unusual but theoretically important context for this process. When strangers participate in a common physical activity, they may encounter situations requiring coordination, mutual assistance, communication, and persistence. Unlike passive co-presence, a shared challenge can require individuals to make their behavior responsive to another person's actions.

The social meaning of physical coordination has received attention in research on behavioral synchrony. Vacharkulksemsuk and Fredrickson examined strangers and found that behavioral synchrony during interaction was associated with higher-quality interpersonal experiences. Their study involved 94 stranger dyads and identified synchrony as a behavioral process related to embodied rapport.

Related research has examined synchrony in collective physical activities. In a study involving group exercise, moderate-intensity exercise was associated with greater cooperation in an economic game, while the researchers also examined the relationship between exercise, synchrony, social bonding, and performance.

A meta-analysis of 42 independent studies involving 4,327 participants found that experimentally manipulated synchrony had positive effects across prosocial behavior, perceived social bonding, social cognition, and positive affect, although the magnitude of effects differed across outcomes. This evidence provides a broader basis for examining coordinated physical activity as a social psychological phenomenon.

Shared physical challenges differ from ordinary synchronized movement because they may involve interdependence. Individuals can sometimes complete a synchronized movement without depending substantially on another person's success. In a shared challenge, however,

successful completion may require participants to adjust their behavior according to the capabilities and actions of others.

This distinction is important for interpersonal trust. Trust often develops when one person must make themselves dependent, at least temporarily, on another person's behavior. If a stranger demonstrates responsiveness and reliability during a shared challenge, the interaction may provide information that changes subsequent expectations.

Research on trust and risk similarly indicates that interpersonal trust is related to situations involving uncertainty and potential vulnerability. Cook and colleagues examined trust building through risk-taking behavior and argued that sequences of risk-taking interactions can contribute to the development of trust relationships.

Shared physical challenges can therefore create a situation in which strangers encounter manageable forms of interdependence. One participant may need another person to maintain coordination, communicate information, provide assistance, or fulfill a shared role.

The psychological importance of such experiences may extend beyond task completion. Successfully navigating a challenge together can create a shared episode that becomes part of the interpersonal history between the participants. Such shared experiences may make subsequent interaction feel less uncertain.

However, the relationship should not be treated as automatic. A challenging activity can also produce frustration, conflict, embarrassment, competition, or perceptions of unequal contribution. Consequently, the psychological consequences of shared physical challenges depend on how participants interpret and experience the interaction.

The present study addresses this issue by examining shared physical challenges as a possible context for early trust formation among strangers.

Problem Statement

The primary problem addressed by this study is the limited understanding of how strangers develop interpersonal trust through shared physical experiences.

Most trust relationships begin with incomplete information. Individuals cannot immediately determine whether a stranger is reliable, cooperative, responsive, or considerate. Consequently, trust must often develop through interactional evidence.

Many everyday activities provide opportunities for such evidence, but shared physical challenges are particularly interesting because they can require immediate behavioral

coordination. Participants cannot simply rely on verbal assurances; their behavior becomes visible through action.

However, shared physical activity can also produce different psychological outcomes depending on its structure. Cooperative challenges may promote mutual dependence, whereas highly competitive challenges may emphasize individual achievement and group boundaries. The central research problem is therefore not whether physical challenge automatically produces trust, but whether shared physical challenge creates interactional conditions that allow strangers to acquire information about one another's reliability and responsiveness.

Research Motivation

The motivation for the study is derived from the intersection of interpersonal trust research and research on shared physical activity. Trust formation is generally studied through conversational interaction, repeated exchange, economic games, organizational relationships, or established social networks. Physical shared experiences offer an additional context in which trust may emerge through coordinated action.

A second motivation concerns the role of behavioral information. During a physical challenge, participants may observe whether another individual communicates effectively, responds to difficulties, maintains commitments, and adjusts behavior to the needs of others. These observations may provide more direct behavioral information than initial verbal impressions.

A third motivation concerns the early stages of relationship formation. Strangers do not begin with established expectations about one another. Shared challenges therefore provide an opportunity to investigate how brief but meaningful experiences may influence initial trust judgments.

2. Literature Review

Interpersonal trust has been conceptualized in multiple ways across psychology and related social sciences. A recurring theme is that trust involves expectations about another person's future behavior under conditions of uncertainty. The person who trusts accepts some degree of vulnerability because another individual's behavior cannot be completely controlled.

Trust is therefore closely connected to cooperation. When people trust another person, they may become more willing to share information, coordinate activities, accept assistance, or invest effort in a joint objective.

Research on trust among strangers has often used behavioral paradigms in which individuals must decide whether to cooperate despite uncertainty about another person's response. Ho and Weigelt's multistage trust-game research specifically examined trust building among strangers and emphasized repeated interaction as a mechanism through which trust relationships can develop.

Cook et al. similarly examined the role of risk taking in trust building and argued that repeated risk-taking behavior can contribute to the development of trust relationships. These findings are conceptually relevant to shared physical challenges because participants may experience manageable forms of dependence on one another.

Physical challenges can introduce a distinctive form of behavioral information. Rather than simply stating that they are dependable, participants can demonstrate reliability through action. Successful coordination may indicate that an individual follows through on responsibilities, adapts to changing circumstances, communicates appropriately, and contributes toward a shared objective.

Shared Activity and Social Bonding

Research on shared physical activity suggests that coordinated action can have meaningful social consequences. Reddish, Fischer, and Bulbulia examined the relationship between group movement, exercise, social bonding, and cooperation. Their work is particularly relevant because it considered both social bonding following exercise and the association between bonding and cooperative performance. Pasted markdown

The relationship between physical activity and social bonding may partly involve synchrony. Synchronous movement creates a form of behavioral coordination in which individuals adjust their actions in relation to one another.

Vacharkulksemsuk and Fredrickson demonstrated that synchrony can emerge naturally among strangers and can be associated with embodied rapport. Their findings suggest that interpersonal connection may involve not only verbal or cognitive processes but also coordinated physical behavior.

Tarr and colleagues investigated synchronized dancing among strangers and reported greater social bonding under synchronous conditions, although their economic-game measure did not show a corresponding increase in cooperation. This distinction is important because feeling socially connected and behaving cooperatively are related but not identical interpersonal outcomes.

Mogan, Fischer, and Bulbulia conducted a meta-analysis of 42 independent studies involving 4,327 participants and found that synchrony had positive effects across prosocial behavior, perceived social bonding, social cognition, and positive affect. Their findings provide broader evidence that coordinated action can influence multiple dimensions of interpersonal response. Lang and colleagues further examined synchrony and cooperation and reported that joint synchronous movement positively affected liking and investment behavior in a Trust Game. Their study also examined pain-threshold changes and considered a possible role for endogenous opioid processes. Pasted markdown

These studies do not establish that all shared physical challenges generate interpersonal trust. Rather, they demonstrate that coordinated physical experiences can influence interpersonal processes that may be relevant to trust formation.

Interdependence and Cooperative Behavior

Interdependence is especially important in the present framework because the behavior of one participant may directly affect the outcome experienced by another. When individuals share responsibility for achieving a common objective, each participant becomes partly dependent on the other's contribution.

Cooperation can therefore provide information about behavioral reliability. If a participant consistently fulfills their role, responds to another person's needs, communicates effectively, and contributes toward the collective objective, the other participant may develop more favorable expectations regarding future interaction.

Research on cooperation and trust has repeatedly demonstrated relationships among expectations about others' behavior, beliefs about cooperation, and cooperative decision making. Experimental research using public-good and related paradigms has shown that trust and expectations concerning others' cooperation can influence cooperative behavior. Shared physical challenges may create a more immediate form of interdependence than abstract cooperation tasks because participants can observe one another's behavior directly. This direct observation may be particularly important for trust development because reliability is demonstrated through action rather than inferred exclusively from verbal statements.

When a stranger demonstrates responsiveness, consistency, and cooperation during a shared challenge, the observer acquires behavioral information that can be used to update expectations about future interaction.

Strangers and Early Relationship Formation

Trust formation among strangers differs from trust within established relationships. Friends, family members, and long-term colleagues possess accumulated information about one another, whereas strangers have little or no prior interpersonal history and must therefore rely more heavily on immediate behavioral cues.

The early interactional period can consequently be viewed as an important stage in relationship development. Small behavioral signals may influence whether individuals perceive one another as dependable, whether they are willing to cooperate again, and whether the relationship is likely to continue.

Vacharkulksemsuk and Fredrickson's work with stranger dyads is particularly relevant because it demonstrates that even brief interpersonal interactions can produce measurable differences in interaction quality. Pasted markdown

The implication for shared physical challenges is that a common activity may provide a concentrated period of behavioral information. A stranger who responds constructively during a demanding activity may be evaluated differently after the interaction than before it because the participant now possesses direct evidence concerning that person's behavior.

Challenge Intensity and Psychological Interpretation

The concept of challenge intensity requires careful treatment. A challenge that is sufficiently demanding to require cooperation may provide meaningful opportunities for interaction, reciprocal assistance, and behavioral observation. However, excessive difficulty may generate stress, frustration, fatigue, perceptions of unfairness, or failure.

The relationship between challenge intensity and trust may therefore be nonlinear in some contexts. Moderate levels of challenge may create meaningful interdependence without overwhelming participants, whereas very low challenge may provide insufficient opportunity for trust-relevant behavioral information. Conversely, excessively demanding conditions may reduce cooperation or create negative interpersonal experiences.

Research involving physical activity has shown that social outcomes can differ according to the characteristics and intensity of the activity. In research examining exercise and social bonding, moderate-intensity exercise was associated with greater cooperation than low-intensity activity. Pasted markdown

This evidence suggests that physical intensity should not be treated as a simple proxy for interpersonal trust. Researchers should assess both the objective demands of the activity and participants' subjective perceptions of difficulty, exertion, fairness, and manageability.

Behavioral Synchrony and Interpersonal Connection

Behavioral synchrony is relevant because shared physical challenges often involve coordinated movement. Participants may walk, climb, carry, paddle, exercise, or perform other activities in temporal or spatial coordination.

Synchrony may influence interpersonal connection by increasing the perception that individuals are acting together rather than as separate actors. Meta-analytic evidence reported by Mogan et al. indicates that synchrony can influence prosocial behavior, perceived social bonding, social cognition, and affect.

However, the literature also indicates that synchrony effects are not uniform across all interpersonal outcomes. Some studies have reported increases in social bonding without corresponding increases in cooperative behavior. Pasted markdown

This distinction reinforces the need to treat interpersonal trust as a specific relational outcome rather than assuming that every form of social bonding, affiliation, or synchrony is equivalent to trust. Trust additionally involves expectations about another individual's future reliability under conditions of uncertainty or dependence.

Shared Experience and Trust Formation

A shared challenge can create a common autobiographical episode between previously unacquainted individuals. Two strangers who successfully navigate an unfamiliar activity together may subsequently share an interpersonal reference point that did not exist before the experience.

Shared experience may therefore reduce interpersonal uncertainty because participants acquire at least one episode of common behavioral history. Each individual has observed how the other communicated, responded to difficulty, managed responsibilities, and behaved during the joint task.

This process differs from simple familiarity because the shared event involves mutual participation and reciprocal observation. Both individuals contribute to the same experience and can evaluate one another's behavior within a meaningful interactional context.

Such experiences may create a basis for future interaction because individuals no longer need to rely entirely on generalized assumptions about unfamiliar others. Instead, they possess

direct behavioral information that may shape subsequent expectations of reliability, responsiveness, cooperation, and trust. Pasted markdown

3. Research Gap

The existing literature provides evidence linking trust, cooperation, synchrony, exercise, and social bonding, but these areas are often examined separately.

- First, trust research commonly uses economic exchange paradigms, repeated games, or organizational contexts. These methods provide strong experimental control but may not fully capture trust formation during shared physical experiences.
- Second, physical-activity research has examined social bonding and cooperation, but interpersonal trust among previously unacquainted participants is less consistently positioned as the central outcome.
- Third, synchrony research demonstrates relationships with social bonding and prosocial responses, but synchrony is not identical to shared physical challenge. A challenge can involve interdependence even when movement is not perfectly synchronized.
- Fourth, there is insufficient conceptual differentiation between shared physical activity, shared challenge, cooperative interdependence, and interpersonal trust.
- Fifth, challenge intensity may influence interaction quality, but excessive challenge could potentially generate negative experiences. This contextual issue deserves greater attention.

The research gap can therefore be expressed as:

There is a need for an integrated interpersonal-psychology framework examining how shared physical challenges may provide behavioral information, reciprocal dependence, and common experiences that contribute to the early formation of trust among strangers.

4. Novelty / Proposed Contribution

The proposed contribution is the integration of shared physical challenge and interpersonal trust formation within a single conceptual framework.

The framework distinguishes ordinary physical co-presence from shared challenge. In a shared challenge, participants have a common objective and some degree of interdependence. The model proposes that shared challenge may influence trust through three primary pathways:

Shared Physical Challenge → Cooperative Interdependence → Behavioral Evidence of Reliability → Interpersonal Trust

A second pathway is:

Shared Physical Challenge → Coordinated Interaction → Shared Experience → Reduced Uncertainty → Interpersonal Trust

A third pathway concerns responsiveness:

Shared Challenge → Mutual Responsiveness → Perceived Dependability → Trust Development

These pathways are proposed theoretical relationships rather than empirically confirmed causal mechanisms.

5. Research Objectives / Research Questions

The primary objective is to examine the conceptual relationship between shared physical challenges and interpersonal trust among strangers.

The specific objectives are:

- To examine shared physical challenge as a context for early interpersonal trust formation.
- To examine cooperative interdependence as a potential pathway linking shared challenge with trust.
- To examine interpersonal responsiveness as a potential indicator of perceived reliability.
- To examine the possible role of shared experience in reducing uncertainty between strangers.
- To distinguish behavioral synchrony, social bonding, cooperation, and interpersonal trust as related but separate constructs.
- To establish an empirically testable framework for future research.

Research Questions

- How may shared physical challenges influence interpersonal trust among strangers?
- Does cooperative interdependence provide behavioral information relevant to trust formation?
- What role may interpersonal responsiveness play in the development of trust?
- How may shared experiences influence uncertainty between previously unacquainted individuals?
- Does challenge intensity influence the strength or direction of the proposed relationship?

- How does behavioral synchrony differ from interpersonal trust within shared physical activities?

6. Methodology

Research Design

The present study adopts a conceptual-methodological interpersonal psychology research design to examine how shared physical challenges may contribute to the development of interpersonal trust among strangers. The framework integrates perspectives on cooperative interdependence, interpersonal responsiveness, perceived reliability, behavioral synchrony, shared experience, and trust formation.

The study does not report a completed empirical experiment and does not present participant-level observations as factual findings. Instead, it develops a structured methodological framework for defining the principal constructs, specifying theoretically plausible relationships among them, identifying appropriate measurement strategies, and outlining procedures for future empirical validation.

Shared physical challenge is treated as the principal explanatory context, while interpersonal trust is the primary relational outcome. Cooperative interdependence, interpersonal responsiveness, perceived reliability, challenge intensity, and behavioral synchrony are incorporated as theoretically relevant mechanisms or contextual variables.

The framework does not assume that physical challenge automatically generates trust. Trust development is expected to depend on how participants experience the interaction, including whether cooperation is required, whether contributions are perceived as fair, whether partners respond adaptively to one another, and whether the activity provides credible behavioral information about reliability.

Study Scope and Data Basis

No original human-participant dataset was collected or analyzed for the present manuscript. Consequently, the study does not report a factual sample size, participant demographic profile, recruitment rate, response rate, or observed distribution of interpersonal trust.

The methodological framework is designed for future empirical implementation involving adults who are previously unacquainted before participating in a structured shared physical challenge.

Future studies should define stranger status operationally before recruitment. Appropriate criteria may include the absence of prior friendship, regular interaction, close acquaintance, or established cooperative history between participants.

Participants may be organized into dyads or small groups depending on the research question. Where experimentally feasible, random assignment to cooperative, low-interdependence, or comparison conditions would strengthen causal inference.

Construct Operationalization

Shared Physical Challenge

Shared physical challenge is defined as a structured activity in which two or more previously unacquainted individuals pursue a common physical objective under conditions requiring some degree of effort, coordination, communication, or mutual adjustment.

The construct should be distinguished from simple physical co-presence. Two individuals may exercise in the same environment without depending on one another. A shared physical challenge requires a meaningful degree of joint involvement.

Relevant characteristics may include perceived difficulty, duration, task complexity, physical demand, degree of cooperation, and level of reciprocal dependence.

Cooperative Interdependence

Cooperative interdependence refers to the extent to which successful task completion depends on coordinated contributions from more than one participant.

Higher interdependence occurs when one participant's actions materially affect the other participant's ability to complete the task. Lower interdependence occurs when participants can complete the activity largely independently.

This construct is important because interdependence creates opportunities for participants to observe whether another individual is reliable, communicative, responsive, and willing to contribute toward a shared objective.

Interpersonal Responsiveness

Interpersonal responsiveness is defined as the extent to which a participant perceives that a partner notices, understands, and appropriately responds to their needs, actions, communication, or difficulties during the shared challenge.

Relevant indicators may include attentive communication, adaptation to another participant's pace or ability, provision of assistance, acknowledgment of difficulty, and appropriate response to changing task demands.

Perceived Reliability

Perceived reliability refers to the expectation that another participant will behave consistently, fulfill agreed responsibilities, and respond dependably during future interaction. Perceived reliability is conceptually distinct from liking or social closeness. A participant may like another person without necessarily considering them dependable.

Interpersonal Trust

Interpersonal trust is defined as a willingness to accept some degree of vulnerability based on positive expectations regarding another person's future behavior.

Trust should therefore be assessed not only through general positive impressions but also through expectations of reliability, honesty, responsiveness, cooperation, and willingness to depend on the other participant.

Measurement Framework

Future empirical research should use validated measures wherever appropriate and should supplement them with carefully developed items when existing instruments do not adequately capture the specific context of shared physical challenge.

The proposed measurement framework should include the following domains:

- shared physical challenge involvement
- perceived challenge intensity
- cooperative interdependence
- interpersonal responsiveness
- perceived reliability
- interpersonal trust;
- behavioral synchrony
- social closeness
- willingness for future interaction
- behavioral cooperation

Interpersonal trust should preferably be measured using both self-report and behavioral indicators. Self-report measures can assess perceived reliability, trustworthiness, honesty, and

willingness to depend on the partner. Behavioral indicators can assess whether participants actually choose to cooperate, share resources, accept vulnerability, or interact again with the same partner.

Challenge intensity should be assessed through both objective task characteristics and participants' subjective perceptions because the same physical activity may be experienced differently depending on ability, prior experience, and current condition.

Proposed Sampling Framework

Future empirical validation should recruit adults who are previously unacquainted before the study.

Eligibility criteria should be defined in advance and should ensure that participants are physically able to complete the selected activity safely. Researchers should also establish exclusion criteria relevant to the physical demands of the task.

The sample should, where feasible, include participants with different levels of prior physical-activity experience to determine whether familiarity with challenging activities alters trust development.

Sample-size requirements should be determined through an a priori power analysis based on the primary analytical model, anticipated effect size, number of experimental conditions or predictors, significance criterion, and desired statistical power.

Proposed Experimental and Prospective Design

A controlled experimental design would provide a strong basis for evaluating the proposed framework.

Participants could first complete baseline measures of generalized trust propensity, social anxiety, prior group-activity experience, and relevant demographic characteristics.

Previously unacquainted participants would then be paired and assigned to a structured activity condition. Depending on the research question, conditions could vary in cooperative interdependence, challenge intensity, or degree of coordination required.

The shared physical challenge should involve a common objective and require meaningful interaction without exposing participants to unnecessary or excessive physical risk.

Immediately after the activity, participants should independently assess their partner's responsiveness, reliability, cooperation, and trustworthiness. Social closeness and willingness for future interaction may also be measured.

A subsequent behavioral task should be used where possible to assess trust through actual decision making rather than relying exclusively on self-report.

A delayed follow-up should be included to determine whether any change in trust persists beyond the immediate emotional or affective response to the shared activity.

Analytical Strategy

Analysis should begin with data-quality assessment, including missing responses, response distributions, outliers, inconsistent records, and potential floor or ceiling effects.

Reliability should be evaluated separately for all multi-item scales. Where new items are developed, exploratory factor analysis may be used to examine dimensional structure, followed by confirmatory factor analysis in an independent or appropriately separated validation sample.

Descriptive statistics should summarize participant characteristics and the principal study variables.

Group comparisons may be used to examine whether participants exposed to different challenge or interdependence conditions differ in post-activity trust, perceived responsiveness, perceived reliability, or willingness for future interaction.

Multivariable analysis should account for relevant baseline characteristics such as generalized trust propensity, prior physical-activity experience, perceived challenge intensity, and pre-existing differences in social confidence.

Mediation analysis may be used to test whether perceived reliability or interpersonal responsiveness helps explain the relationship between shared physical challenge and subsequent trust.

Moderation analysis may be used to examine whether the proposed relationship varies according to challenge intensity, perceived fairness, physical ability, prior activity experience, or behavioral synchrony.

Where repeated trust measurements are obtained, longitudinal or mixed-effects models should be considered to examine change across time.

Behavioral Trust Validation

Behavioral validation is important because self-reported trust does not always correspond with actual willingness to accept vulnerability.

Future studies should therefore include at least one behavioral indicator where feasible. Appropriate outcomes may include willingness to cooperate with the same partner, allocation decisions, partner selection, information sharing, resource sharing, or willingness to rely on the partner in a subsequent task.

Behavioral measures should be selected according to the research context and should not be interpreted as equivalent to all dimensions of interpersonal trust.

Reliability and Validity Assessment

The proposed measures should be evaluated for internal consistency, measurement stability, and construct validity.

Construct validity should determine whether interpersonal trust can be distinguished from social closeness, liking, behavioral synchrony, perceived responsiveness, and perceived reliability.

Convergent validity should be examined by determining whether theoretically related trust indicators are appropriately associated.

Discriminant validity should be examined to ensure that trust is not merely reproducing broader positive affect or social bonding.

Predictive validity should assess whether post-challenge trust predicts subsequent cooperative decisions or willingness for future interaction.

Incremental validity should determine whether shared physical challenge variables explain variation in trust beyond generalized trust propensity and baseline interpersonal characteristics.

Evaluation Criteria

The methodological framework should be evaluated according to the following criteria:

- **Construct clarity:** Whether shared physical challenge, cooperative interdependence, responsiveness, reliability, and trust are defined as conceptually distinct constructs.
- **Measurement reliability:** Whether the proposed instruments demonstrate acceptable internal consistency and stability.
- **Construct validity:** Whether trust can be distinguished empirically from social bonding, liking, synchrony, and perceived closeness.
- **Behavioral validity:** Whether self-reported trust corresponds with observable cooperative or vulnerability-related decisions.

- **Predictive validity:** Whether challenge-related experiences predict subsequent trust or cooperative behavior.
- **Incremental validity:** Whether shared physical challenge variables explain additional variation beyond baseline trust propensity and individual differences.
- **Temporal validity:** Whether changes in trust persist beyond the immediate post-activity period.
- **Context sensitivity:** Whether findings vary across challenge intensity, interdependence, activity type, physical ability, or perceived fairness.
- **Reproducibility:** Whether sampling, task procedures, measurement, preprocessing, analysis, and reporting are documented sufficiently for independent replication.

Statistical Reporting

Future empirical studies should report exact sample sizes, descriptive statistics, reliability estimates, effect sizes, confidence intervals, missing-data procedures, model assumptions, and diagnostic checks.

Statistical significance should not be interpreted in isolation. The magnitude, precision, theoretical relevance, and practical meaning of observed relationships should also be considered.

Confirmatory hypotheses should be distinguished from exploratory analyses, and major analytical decisions should preferably be specified before outcome data are examined.

Ethical Considerations

The present conceptual-methodological study does not report original human-participant data. Any future empirical research involving physical challenges should obtain appropriate institutional ethics approval where required and should include informed consent, participant screening, task-specific risk assessment, appropriate supervision, and procedures for responding to discomfort, fatigue, or withdrawal.

Physical challenge tasks should be designed to produce meaningful cooperation without unnecessary risk. Participants should be informed that participation is voluntary and that they may discontinue involvement without penalty.

Participant privacy and confidentiality should be protected throughout data collection, storage, analysis, and reporting.

Methodological Transparency

The present study distinguishes theoretical propositions from empirical findings. No numerical relationship between shared physical challenge and interpersonal trust is presented as an observed effect in the current manuscript.

The proposed framework is intended to provide a transparent basis for future empirical validation. Subsequent studies should report participant characteristics, stranger-status criteria, task design, assignment procedures, measurement instruments, reliability estimates, analytical decisions, model assumptions, and uncertainty estimates in sufficient detail to permit independent evaluation and replication.

6. Results

The present study does not report empirical participant outcomes or simulation-derived effect estimates. Instead, the Results section presents the principal conceptual and methodological outputs generated through development of the proposed framework for examining how shared physical challenges may contribute to interpersonal trust among strangers.

The resulting framework identifies shared physical challenge as the principal interactional context and interpersonal trust as the primary relational outcome. Cooperative interdependence, interpersonal responsiveness, perceived reliability, behavioral synchrony, challenge intensity, and shared experience are treated as analytically distinct constructs because each represents a different component of the proposed trust-development process.

The framework further emphasizes that shared physical challenge should not be interpreted as an automatic cause of trust. Rather, trust may develop when the activity creates opportunities for participants to observe one another's behavior, evaluate responsiveness, experience reciprocal dependence, and form expectations concerning future reliability.

Construct Differentiation

The first methodological result concerns the distinction among shared physical challenge, cooperative interdependence, interpersonal responsiveness, perceived reliability, and interpersonal trust.

Shared physical challenge refers to a structured activity requiring joint participation under conditions of physical effort, coordination, or common task demands. Cooperative interdependence represents the extent to which successful task completion depends on the coordinated contribution of more than one participant.

Interpersonal responsiveness refers to the degree to which one participant perceives that another notices, understands, and responds appropriately to their needs, actions, or communication during the activity.

Perceived reliability represents the expectation that a partner will behave consistently, fulfill responsibilities, and respond dependably in future interaction.

Interpersonal trust is treated as a distinct relational outcome involving willingness to accept some degree of vulnerability based on positive expectations of another person's future behavior.

Table 1. Proposed Measurement and Analytical Structure

Construct	Proposed Measurement Domain	Principal Analytical Role
Shared Physical Challenge	Common objective, joint effort, physical demand, coordination requirement	Primary interactional context
Cooperative Interdependence	Mutual dependence, shared task responsibility, reciprocal contribution	Proposed explanatory mechanism
Interpersonal Responsiveness	Adaptation, assistance, communication, response to partner needs	Proposed interpersonal mechanism
Perceived Reliability	Dependability, consistency, fulfillment of responsibilities	Potential mediator
Behavioral Synchrony	Temporal or spatial coordination of movement	Complementary process
Interpersonal Trust	Expected reliability, willingness to depend, confidence in future cooperation	Primary relational outcome

Interpretation: The proposed structure separates activity characteristics from interpersonal mechanisms and trust outcomes. This distinction is important because physical co-presence, coordination, social bonding, and trust are related but should not be treated as conceptually equivalent.

Proposed Trust-Development Pathway

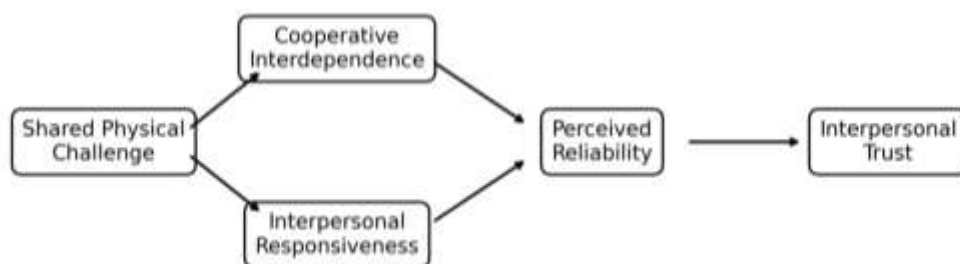
The second methodological output is the specification of a proposed pathway linking shared physical challenge with interpersonal trust.

A shared physical challenge can create opportunities for cooperative interdependence and interpersonal responsiveness. These interactional experiences may provide behavioral

information about whether a partner is dependable, attentive, and willing to contribute to a shared objective.

Perceived reliability is therefore positioned as an important mechanism through which observed behavior during a challenge may inform later trust judgments.

Graph 1. Proposed Pathway from Shared Physical Challenge to Interpersonal Trust



Conceptual pathway only; arrows indicate proposed relationships for future empirical testing.

Graph Interpretation: The graph represents a conceptual pathway in which shared physical challenge may promote cooperative interdependence and interpersonal responsiveness. These processes may contribute to perceived reliability, which may subsequently influence interpersonal trust. The arrows represent proposed theoretical relationships for future empirical testing and do not indicate established causal effects.

Proposed Behavioral Trust Indicators

The framework identifies both psychological and behavioral indicators that may be used to evaluate interpersonal trust in future empirical research.

Table 2. Proposed Indicators for Empirical Assessment of Interpersonal Trust

Assessment Domain	Example Indicator	Preferred Assessment Approach
Perceived Reliability	Expectation that the partner will fulfill responsibilities	Validated self-report measure
Interpersonal Responsiveness	Perceived adaptation, assistance, and attentive communication	Post-task questionnaire
Behavioral Trust	Willingness to cooperate or depend on the same partner	Structured behavioral task
Social Closeness	Perceived interpersonal connection after the shared activity	Validated closeness measure
Future Interaction	Willingness to work or interact with the partner again	Behavioral choice or questionnaire

Cooperative Behavior	Resource sharing, information sharing, or joint decision making	Observed behavioral measure
Trust Persistence	Stability of trust across a delayed follow-up	Longitudinal reassessment

Interpretation: Future empirical validation should combine self-reported trust with behavioral indicators. Reliance on self-report alone may not adequately establish whether perceived trust corresponds with actual willingness to cooperate or accept vulnerability.

Proposed Temporal Structure

A prospective or experimental design emerged as the preferred structure for future validation. Participants should ideally be assessed before the shared challenge to establish baseline trust propensity and relevant interpersonal characteristics. Trust-related perceptions should then be assessed immediately after the activity and again after a delayed interval where feasible.

This temporal structure would permit researchers to distinguish immediate post-activity responses from more persistent trust development.

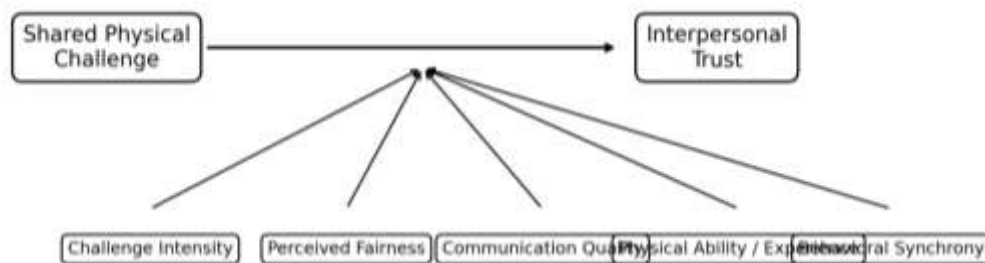
A delayed measurement is particularly important because elevated trust immediately following successful cooperation may partly reflect temporary positive affect or task satisfaction rather than stable interpersonal expectations.

Proposed Moderation Structure

The methodological framework indicates that the relationship between shared physical challenge and trust is unlikely to operate uniformly across all activities or participants.

Relevant contextual factors may include challenge intensity, perceived fairness, communication quality, prior physical-activity experience, participant capability, behavioral synchrony, cooperative versus competitive task structure, and perceived contribution balance.

Graph 2. Proposed Contextual Factors Shaping the Challenge–Trust Relationship



Conceptual moderation structure; no empirical effect sizes or contribution percentages are implied.

Graph Interpretation: The graph identifies challenge intensity, perceived fairness, communication quality, physical ability or prior experience, and behavioral synchrony as

contextual factors that may influence the proposed relationship between shared physical challenge and interpersonal trust. The model is conceptual and does not imply empirical effect sizes or relative numerical contributions.

Proposed Analytical Sequence

Future empirical validation should proceed through a structured analytical sequence.

- First, data quality should be evaluated through examination of missing responses, inconsistent records, distributions, and potential outliers.
- Second, the reliability and dimensionality of multi-item constructs should be assessed.
- Third, construct validity should determine whether interpersonal trust can be distinguished from social closeness, perceived reliability, behavioral synchrony, and general positive affect.
- Fourth, descriptive and correlational analyses should characterize preliminary relationships among the principal variables.
- Fifth, multivariable analysis should examine whether shared physical challenge characteristics contribute to subsequent trust after accounting for baseline trust propensity, individual differences, and relevant contextual factors.
- Sixth, mediation analysis should examine whether perceived reliability or interpersonal responsiveness helps explain the proposed association between shared challenge and trust.
- Seventh, moderation analysis should determine whether challenge intensity, perceived fairness, physical ability, communication quality, or behavioral synchrony alter the strength or direction of the relationship.

Finally, repeated-measures or longitudinal models should be used where trust is assessed across multiple time points.

Methodological Findings

The methodological development produced five principal findings.

- First, shared physical challenge should be distinguished from simple physical co-presence. Trust-relevant information is more likely to emerge when participants are required to coordinate, communicate, or depend on one another.
- Second, cooperative interdependence represents a theoretically important mechanism because it creates opportunities to observe whether a partner behaves reliably under shared task demands.

- Third, interpersonal responsiveness provides direct behavioral information that may influence perceptions of dependability and future trust.
- Fourth, interpersonal trust should be measured separately from social bonding, liking, or closeness. Positive interpersonal feelings do not necessarily imply expectations of future reliability.
- Fifth, challenge intensity and contextual conditions should not be ignored. Moderate and appropriately structured challenges may provide useful interactional information, whereas excessive difficulty, unequal contribution, or conflict may weaken trust rather than strengthen it.

Interpretation of Results

The present Results section should be interpreted as reporting the outputs of conceptual and methodological framework development rather than empirical behavioral findings.

No participant-level means, percentages, regression coefficients, p-values, effect sizes, prevalence estimates, or causal effects are claimed.

The principal contribution of the Results section is the specification of a testable structure that distinguishes shared challenge from cooperation and trust, identifies theoretically relevant mechanisms, proposes behavioral trust indicators, incorporates contextual moderators, and establishes a transparent basis for future experimental and longitudinal validation.

7. Discussion / Critical Discussion

Results Interpretation

The present conceptual-methodological framework suggests that shared physical challenges may provide a distinctive interpersonal context in which strangers acquire behaviorally relevant information about one another. The proposed relationship should not be interpreted as evidence that physical challenge itself produces trust. Rather, the framework identifies cooperative interdependence, interpersonal responsiveness, successful coordination, and perceived reliability as mechanisms through which a shared challenge may become psychologically meaningful. When participants must adjust their actions to one another, contribute toward a common objective, and respond to changing task demands, they gain direct information about how an unfamiliar partner behaves under conditions involving uncertainty and mutual dependence.

From this perspective, the trust-relevant value of a shared physical challenge lies in the behavioral evidence generated during the interaction. A partner who communicates effectively, adapts appropriately, fulfills a shared responsibility, and provides assistance when necessary may be perceived as more dependable than a partner whose behavior is inconsistent or unresponsive. This interpretation is consistent with trust-development perspectives that emphasize interaction and behavioral evidence rather than initial impressions alone. Ho and Weigelt's work on trust building among strangers, for example, demonstrates how repeated interaction can provide information that contributes to the formation of trust-related expectations.

Behavioral synchrony is also relevant to the framework, but it should not be treated as equivalent to interpersonal trust. Coordinated movement may facilitate rapport, social connection, or a sense of acting together, whereas trust involves expectations concerning another person's future reliability under conditions of uncertainty or vulnerability. The framework therefore treats synchrony as a complementary interpersonal process rather than as a direct substitute for trust. The critical issue is whether coordinated activity provides sufficiently meaningful behavioral information for participants to revise their expectations about one another's dependability and future behavior.

Comparison with Previous Studies

The proposed framework is consistent with previous research indicating that coordinated physical activity can influence social bonding, cooperation, and other interpersonal outcomes. Reddish, Fischer, and Bulbulia examined relationships among synchronized activity, shared intentionality, cooperation, and social bonding, providing a relevant basis for understanding how coordinated physical experiences can acquire social significance. Similarly, Vacharkulksemsuk and Fredrickson demonstrated that behavioral synchrony among strangers can contribute to embodied rapport, supporting the broader proposition that coordinated interaction may influence the quality of early interpersonal encounters.

Meta-analytic evidence reported by Mogan, Fischer, and Bulbulia further indicates that experimentally manipulated synchrony can influence prosocial behavior, perceived social bonding, social cognition, and positive affect. Lang and colleagues extended this line of research by examining synchronous movement alongside cooperation-related outcomes and reported associations with liking and Trust Game investment. These studies provide an important foundation for the present framework because they demonstrate that physical

coordination can have measurable interpersonal consequences. However, they do not establish that shared physical challenge, cooperative interdependence, and interpersonal trust are interchangeable constructs.

The distinction is reinforced by findings showing that social bonding and cooperative behavior do not always change together. Tarr and colleagues reported increased social bonding following synchronized movement without a corresponding increase in cooperation in an economic-game measure. This indicates that feeling socially connected to another individual does not necessarily imply increased willingness to depend on that person or accept vulnerability in a later interaction. The present framework therefore extends prior research by emphasizing shared challenge, reciprocal dependence, perceived responsiveness, and behavioral evidence of reliability, rather than treating synchrony or social closeness alone as sufficient indicators of trust formation.

Potential Sources of Variation in Future Empirical Findings

Future empirical findings may vary substantially according to the structure and interpretation of the shared physical challenge. Cooperative activities are likely to provide different interpersonal information from activities in which participants perform alongside one another but remain functionally independent. Cooperative interdependence increases the opportunity to observe whether a partner communicates effectively, fulfills responsibilities, adjusts to another person's needs, and contributes fairly toward a common objective. By contrast, an activity requiring little mutual dependence may produce physical co-presence or synchrony without generating strong evidence about reliability.

Challenge intensity may also influence trust-related responses. A sufficiently demanding activity may create meaningful opportunities for cooperation and reciprocal assistance, whereas excessive difficulty may produce frustration, fatigue, conflict, or negative affect. Perceived fairness is similarly important. If one participant believes that responsibilities were distributed unevenly or that the other participant contributed insufficiently, the shared experience may weaken rather than strengthen positive expectations. Communication quality may further moderate the relationship because activities requiring clear information exchange provide greater opportunities to observe responsiveness and dependability than tasks involving limited interpersonal communication.

Individual and contextual differences provide additional alternative explanations. Baseline trust propensity, prior experience with group exercise, physical ability, social confidence,

behavioral synchrony, and willingness to interact with unfamiliar people may influence how participants interpret the same activity. The cooperative or competitive framing of the challenge may also alter its interpersonal meaning, as cooperative structures emphasize mutual success whereas competitive structures may increase social comparison or self-focused performance concerns. Novelty may further affect outcomes because an initial shared challenge provides particularly salient information when participants begin with almost no interpersonal history. Future experimental and longitudinal research should therefore evaluate these variables explicitly rather than assuming that the effect of shared physical challenge on trust will be uniform across participants, activities, or social contexts.

8. Research Contribution / Implications

The principal contribution of this study is the conceptual integration of shared physical challenge and interpersonal trust among strangers.

The framework emphasizes that trust may emerge from behavioral evidence rather than solely from verbal communication. A stranger's behavior during a shared challenge can provide information about reliability, responsiveness, cooperation, and willingness to support another participant.

The second contribution is the distinction between shared activity and shared challenge. Physical co-presence does not necessarily create interdependence. A shared challenge involves a common objective and requires participants to coordinate their actions.

The third contribution is the separation of trust from social bonding. Research on synchrony indicates that physical coordination can increase perceived social connection, but social bonding does not necessarily imply increased cooperative behavior. The present framework therefore treats trust as a distinct outcome requiring future behavioral or attitudinal verification.

The fourth contribution is methodological. Future research can combine self-report trust measures with behavioral trust tasks, allowing researchers to examine whether subjective trust corresponds with actual cooperative decisions.

The study has several implications:

- **Interpersonal psychology:** Shared challenges can provide a useful naturalistic context for examining early trust formation.
- **Social interaction research:** Behavioral responsiveness can be measured alongside verbal communication.

- **Physical-activity research:** Social outcomes should be examined alongside physical outcomes.
- **Group research:** Interdependence can be operationalized rather than assumed from group membership.
- **Experimental research:** Stranger dyads provide an opportunity to examine trust development from a common baseline.
- **Program evaluation:** Researchers should distinguish constructive shared challenges from activities that create excessive stress or unequal participation.

These implications remain theoretical until tested with real participant data.

9. Conclusion

Interpersonal trust among strangers develops under conditions of uncertainty because individuals initially possess limited information about another person's reliability, responsiveness, and intentions. Shared physical challenges may provide a distinctive interpersonal context in which some of this uncertainty can be reduced through direct behavioral observation, reciprocal dependence, communication, and coordinated action.

The present framework does not assume that participation in a shared physical challenge automatically produces trust. Instead, it proposes that trust development may depend on the quality of the interaction and on the behavioral information generated during the activity. Cooperative interdependence can create opportunities for participants to observe whether an unfamiliar partner fulfills responsibilities, adapts to changing task demands, provides appropriate assistance, and contributes reliably toward a common objective. These observable behaviors may shape subsequent expectations about dependability and future cooperation.

The framework also emphasizes the importance of interpersonal responsiveness and perceived reliability. A participant who communicates effectively, responds appropriately to another person's needs, and contributes consistently may provide stronger trust-relevant information than a participant whose behavior is inconsistent or unresponsive. Behavioral synchrony and social bonding may support positive interpersonal experiences, but they should not be treated as equivalent to trust, which involves expectations about another person's future behavior under conditions of uncertainty or vulnerability.

Challenge intensity is another important contextual consideration. A manageable challenge may provide sufficient interdependence to generate meaningful behavioral information without overwhelming participants. Excessive difficulty, perceived unfairness, unequal

contribution, conflict, or competitive pressure may instead weaken positive expectations and reduce the likelihood of trust development. The interpersonal consequences of a shared challenge therefore depend not only on the physical activity itself but also on how the task is structured and experienced.

Future empirical research should test the proposed framework through controlled experimental, prospective, and longitudinal designs. Such studies should combine validated self-report measures of interpersonal trust with behavioral indicators of cooperation and willingness to accept vulnerability. Researchers should also assess cooperative interdependence, interpersonal responsiveness, perceived reliability, challenge intensity, behavioral synchrony, perceived fairness, and relevant individual differences. Repeated measurement would be particularly useful for determining whether any trust-related changes persist beyond the immediate post-activity period.

Overall, shared physical challenges represent a theoretically valuable context for investigating the early development of interpersonal trust among strangers. Their significance lies not simply in physical exertion, but in the opportunity they create for previously unacquainted individuals to observe one another's behavior while jointly confronting a common task. The proposed conceptual-methodological framework therefore provides a structured basis for future empirical validation of how cooperative interdependence, responsiveness, and behavioral evidence of reliability may contribute to the formation of trust.

10. Limitations

The principal limitation of the present study is the absence of original empirical validation. The proposed framework is conceptual-methodological and has not yet been tested using participant-level data. Consequently, the relationships among shared physical challenge, cooperative interdependence, interpersonal responsiveness, perceived reliability, and interpersonal trust should be interpreted as theoretically grounded propositions rather than established empirical effects.

A second limitation concerns the heterogeneity of shared physical challenges. Such activities may differ substantially in intensity, duration, complexity, physical demand, risk, coordination requirements, level of interdependence, and competitive structure. These differences may alter the psychological meaning of the experience and may influence whether the activity generates trust-relevant behavioral information. Findings obtained from

one type of challenge should therefore not automatically be generalized to other forms of shared physical activity.

A third limitation concerns the distinction between interpersonal trust and related constructs such as social bonding, liking, affiliation, and perceived closeness. Participants may feel more connected to another person after a shared activity without necessarily developing stronger expectations of that person's future reliability or dependability. Future empirical studies should therefore measure these constructs separately and evaluate their discriminant validity.

A fourth limitation involves self-selection. Individuals who voluntarily participate in physically challenging or cooperative group activities may differ systematically from those who avoid such settings. Differences in baseline trust propensity, sociability, physical confidence, prior group-exercise experience, or willingness to interact with unfamiliar people could influence observed outcomes and limit generalizability.

A fifth limitation concerns variation in physical ability and prior experience. The same challenge may be perceived as manageable by one participant and excessively demanding by another. Differences in fitness, coordination, prior exposure to similar activities, fatigue, and perceived competence may influence both the quality of the interaction and subsequent trust judgments.

A sixth limitation is that shared challenges can generate negative as well as positive interpersonal experiences. Miscommunication, unequal contribution, perceived unfairness, frustration, conflict, excessive competition, or failure to coordinate may weaken trust rather than strengthen it. The proposed framework therefore should not be interpreted as assuming that shared challenge has uniformly positive relational consequences.

A seventh limitation concerns the timing of trust assessment. Trust measured immediately after a successful challenge may partly reflect temporary positive affect, relief, arousal, or satisfaction associated with task completion. Delayed follow-up assessment is therefore necessary to determine whether any change in interpersonal trust persists beyond the immediate post-activity period.

An eighth limitation concerns contextual generalizability. The proposed relationships may vary across activity types, cultural settings, age groups, institutional contexts, group sizes, and levels of prior familiarity. The meaning of cooperation, dependence, responsiveness, and acceptable physical challenge may differ across social and cultural environments. Future

research should therefore test the framework across diverse contexts before broader generalizations are made.

11. Future Work

Future research should first use controlled experiments involving previously unacquainted participant dyads. Participants could complete cooperative shared challenges and comparison activities, followed by measures of interpersonal trust.

Second, researchers should examine the role of challenge intensity. Low, moderate, and high challenge conditions could be compared while ensuring that all activities remain ethically appropriate and physically suitable for participants.

Third, future studies should manipulate interdependence. One condition could require participants to coordinate closely, whereas another could involve parallel individual activity. This would help distinguish the effect of physical activity from the effect of mutual dependence.

Fourth, behavioral measures should complement self-report questionnaires. Trust-game decisions, willingness to cooperate, information sharing, and partner-selection decisions could provide behavioral indicators.

Fifth, researchers should examine whether trust persists. Measurements immediately after the activity, after a delay, and following a subsequent interaction could distinguish temporary affect from more stable interpersonal expectations.

Sixth, behavioral synchrony should be measured independently. This would allow researchers to determine whether synchrony explains part of the relationship between shared physical activity and trust.

Seventh, future studies should examine perceived partner responsiveness. Participants should report whether they believed the stranger listened, adapted, communicated, assisted, and responded appropriately.

Eighth, researchers should investigate whether shared challenges produce generalized trust toward broader categories of people or only increased trust toward the specific interaction partner.

Ninth, future work should consider individual differences in trust propensity, social anxiety, prior group-exercise experience, and openness to unfamiliar social interaction.

Finally, future research should use preregistered hypotheses, appropriate sample-size planning, validated measures, transparent reporting, and effect-size estimates with confidence

intervals. These practices would allow stronger conclusions regarding the psychological mechanisms linking shared physical challenges with interpersonal trust.

12. Declarations

Conflict of Interest

The author declares no conflict of interest relevant to the preparation, interpretation, or presentation of this manuscript.

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No external funding was received for the preparation of this conceptual-methodological study.

Ethics Statement

No original human-participant data were collected or analyzed for this conceptual-methodological study. The manuscript does not report participant recruitment, intervention, behavioral experimentation, or identifiable personal data.

Any future empirical investigation involving physical activity and human participants should obtain appropriate institutional ethics approval where required and should include informed consent, participant screening, task-specific risk assessment, appropriate supervision, privacy protection, and suitable participant-safety procedures before data collection.

Data Availability

No original empirical participant dataset was generated or analyzed for the present study. Accordingly, no participant-level dataset is associated with this manuscript. The conceptual and methodological framework presented in the article is intended to support future empirical validation.

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