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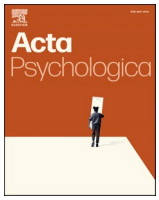

Justice and L2 motivational network: An EBICglasso based analysis of English language learners' motivation, goal orientation, mindset, and justice in the classroom☆

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ABSTRACT

This study models second language (L2) motivational factors and classroom justice in English as a Foreign Language (EFL) learners via a network psychometric method. The study formulates a network of motivational aspects including expectancy beliefs, goal orientations, ideal and ought-to L2 selves, learning experiences, intended effort, mindsets, and anxiety and distributive, procedural, and interactional justice dimensions as an interconnected system based on the expectancy-value-cost theory, achievement goal theory, the L2 Motivational Self System, implicit theories of ability, and organizational justice frameworks. The analysis of the data on 434 Turkish undergraduate EFL students using network analysis demonstrates that the study has a moderately dense network with two major communities: cohesive justice community that offers social-relational scaffolding and motivational-affective community that focuses on English learning experience, ideal L2 self, and intended effort. The most central node, which has a significant impact, is intended effort, and the facets of justice, especially interactional and procedural justice, serve as bridges between social perceptions and cognitive-affective engagement. Perceived costs and fixed mindsets are maladaptive factors with inhibitory functions and relative isolation. The results build on the dynamic systems models of L2 acquisition by integrating the perceptions of justice into the motivational ecologies of the learners and emphasizing their control role in promoting persistence and reducing avoidance. The network approach, methodologically, provides a replicable framework of future research, and implications of the study in practice with regard to pedagogical intervention to promote justice to improve motivational outcomes.

1. Introduction

The motivation to persist, engage, and succeed in language learning has been a key issue in the field of educational psychology and second language (L2) acquisition (SLA) research. Motivation has been generally accepted as a complex construct that includes cognitive assumptions of ability and worth, affective feelings of pleasure or fear, goal-directed efforts, and self-regulatory actions (Dörnyei & Ryan, 2015; Eccles & Wigfield, 2002). In the context of foreign language learning, the motivational dynamics are influenced by the future self-concepts of the learners (Dörnyei, 2009), implicit theories of ability (Dweck, 2006) and the future goals that the learners have in the academic settings (Elliot & McGregor, 2001). The recent theoretical developments have stressed that motivation is not to be perceived as a set of independent characteristics, but as a dynamic inter-relational system where beliefs, emotions, goals, and behaviors should be regarded as mutually influencing each other over time (Hiver et al., 2024; Waninge et al., 2014).

In line with this complexity of motivation, an emerging literature has indicated the importance of perceived fairness in the school setting. Distributive fairness in grading, procedural transparency in decision-making, and interactional respect in teacher-student relations have been demonstrated to have an impact on the engagement, satisfaction, and academic performance of students (Chory, 2023; Chory-Assad & Paulsel, 2004; Paulsel et al., 2005; Rasooli et al., 2019). The more learners feel that their instructors are fair and respectful, the more they become willing to put effort into it, engage actively, and have positive

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attitudes to learning (Estaji et al., 2023; Rasooli et al., 2023). On the other hand, unfair treatment may cause disengagement, anxiety, and lack of motivation (Rasooli et al., 2019). Although the significance of both motivational constructs and justice perceptions has been established, these two areas have been studied separately to a large extent (Molinari & Mameli, 2018; Rasooli et al., 2023). Limited research has rigorously investigated the extent to which the perceptions of fairness are constituted as part of the overall motivational systems in a learner, and whether justice serves as a scaffolding or a driving force behind motivational engagement.

Moreover, to-date the majority of methods of examining motivation have generally been based on latent variable models like structural equation modeling (SEM) that presuppose that observed indicators are manifestations of latent variables (e.g., motivation or self-efficacy). Although such techniques have provided useful information, they are based on reflective measurement model that can blur the direct, reciprocal relationships between certain motivational aspects (Borsboom & Cramer, 2013). Conversely, psychological network analysis is a conceptual framework that views constructs as systems of reinforcing factors, with expectancy beliefs, learning enjoyment, and justice perceptions being modeled as nodes that are linked by regularized partial correlations (Epskamp & Fried, 2018). The following benefits are associated with this network approach: researchers can determine which particular aspects are most central or influential in the system, identify cohesive subnetworks or communities, and find out whether some variables act as bridges between conceptually different domains (Jones et al., 2021). Using this framework to study the intersection of motivation and justice, we can no longer be content with descriptive correlations, but can begin to trace the functional architecture of the motivational ecologies of learners.

1.1. L2 acquisition motivational architectures

The Expectancy-Value-Cost (EVC) theory suggests that the behavior of achieving is determined by the beliefs of the learners regarding the success (expectancy), the significance or utility of the task (value), and the perceived costs of the task (time, effort, or alternative) (Eccles & Wigfield, 2002; Wigfield & Eccles, 2020). In L2 settings, expectancy and value can be associated with higher predictors of effort, persistence and resilience (Namaziandost & Çelik, 2025), and perceived cost has a lower effect on engagement and instead may increase avoidance (Pekrun, 2006; Schoeffel et al., 2022).

Achievement goal theory offers a complementary perspective because it differentiates between mastery/task goals (focused on learning and improvement) and performance goals (focused on showing ability) and their approach/avoid valences (Midgley et al., 1998). Goals of mastery are likely to result in deep processing, adaptive help-seeking and failure resilience; performance-avoidance goals are associated with anxiety and self-handicapping, especially in evaluative L2 learning environments (Anderman & Wolters, 2006; Elliot & Church, 1997). It is very unusual for these goal states to be in isolation: they also co-vary with expectancy-value beliefs and with how learners formulate their conception of future selves.

The L2 Motivational Self System (L2MSS) redefines the concept of motivation in terms of the selves of the language learners: Ideal L2 Self (self-image of a competent L2 user), Ought-to L2 Self (social expectations and responsibilities), and Learning Experience (affect in the classroom) (Dörnyei, 2005; Dörnyei & Ushioda, 2013). Well established predictors of intended effort and actual engagement include ideal-self imagery and positive learning experiences, whereas ought-to pressures may be useful in motivating behavior but tend to involve anxiety and avoidance when felt to be controlling (Papi, 2010; Dörnyei, 2019; Wen, 2024; Wu, 2024; Zhang & Lai, 2024) particularly among learners with growth.

Lastly, the ability theories (implicit) (fixed versus growth) influence the learning interpretation of difficulty. Growth mindsets help a person to be persistent and adaptive to strategies; fixed mindsets enhance threat reactions when being evaluated (Dweck, 1999; Dweck et al., 1995). The beliefs are important in language classrooms where errors are constantly surfacing since the difficulty can be interpreted either as diagnostic (changeable) or condemning (immutable), with divergent motivational implications (Lou & Noels, 2019; Papi et al., 2021).

1.2. Justice as a social controller of motivation

Similar to personal beliefs and goals, classroom justice explains the perception of students that outcomes, procedures, and interpersonal treatment are fair (distributive justice), consistent, transparent, and voice-sensitive (procedural justice), and respectful and empathetic (interactional justice) (Greenberg, 1987; Colquitt, 2001). Justice climates are not mere satisfaction of the moral intuitions: they fine-tune the motivational system. Fairness indicates that hard work will not go unrewarded and that errors will not be corrected in a whimsical manner, which promotes value appraisals, mastery objectives and risk taking in L2 communication (Tyler & Blader, 2003). Conversely, the perceived unfairness increases the cost, promotes performance-avoidance objectives, and increases anxiety, which are the established deterrents of language use and development (Ismayilli, 2025; Lou & Noels, 2020; Pekrun, 2006).

This motivation of justice in the classroom setting has started to be validated by emerging studies. As an illustration, a recent study has operationalized these dimensions in the classroom setting, demonstrating that the perceptions of fairness are linked to engagement and achievement (Estaji et al., 2023). The other research conducted by Rasooli et al. (2019) revealed that the perception of distributive, procedural, and interactional fairness influenced emotional response and classroom behavior in students: when treated fairly, they were more engaged, and when they perceived injustice, they withdrew and disengaged (Rasooli et al., 2019). On the same note, procedural justice has been found to promote intrinsic motivation and task performance, which underscores its contribution to the maintenance of learning-oriented behavior (Zapata-Phelan et al., 2009). Furthermore, a systematic review by Baniasadi et al. (2023) also confirmed that fairness in assessment is multidimensional and predicts engagement and achievement especially when combined in instructional, procedural, and interpersonal domains (Baniasadi et al., 2023). Despite this development, studies that directly relate classroom justice to motivational mechanisms in second language learning are few. The majority of the current research is based on general education or assessment settings, and there is a gap in the knowledge concerning the functioning of justice perceptions in the specific interpersonal and intercultural relationships in L2 classrooms.

1.3. Research gap

Although much has been researched on motivation in the SLA process and there is increased interest in teachers' classroom justice, there are still three important gaps. To begin with, the majority of SLA literature considers motivation and justice as two distinct areas that do not influence each other and investigates them simultaneously instead of the interconnected parts of an intertwined psychological mechanism although researchers in the field of psychology in different contexts confirm it (Giamos et al., 2023; Güney & Uysal, 2021). Although positive relationships have been reported in correlational studies between perceptions of fairness and motivational outcomes (Chory-Assad, 2002; Horan et al., 2010), we do not have a thorough insight on how justice is entangled with expectancy beliefs, goal orientations, L2 motivational self and affective experiences such as anxiety. Are the perceptions of doing justice immediate motivational activators or are they background conditions that stabilize and sustain other motivational processes? It is one of the questions that are not answered.

Second, the current motivational studies have utilized variable-

centered, latent-factor methods (SEM, CFA) that group items into general constructs (e.g., Wei & Wang, 2025). Such approaches are based on a factor structure that is unidimensional or hierarchical and consider particular aspects (e.g., ideal L2 self, learning experience, intended effort) as substituable predictors of underlying motivation. Nevertheless, this method can conceal a vital heterogeneity in the interaction of various motivational components. Indicatively, intrinsic enjoyment and performance-avoidance objectives can be held by the same learner but have contrary effects on engagement. Network analysis is used to mitigate this disadvantage by modeling every facet of it as a specific node, showing which particular elements are the most influential, which are in cohesive clusters, and which ones work independently (Hiver et al., 2024). Consequently, it is necessary to conduct a study that applies network analysis to simultaneously plot expectancy-value beliefs, goal orientations, L2 motivational selves, mindsets, and classroom justice in a unified model.

Third, although research on justice has determined that distributive, procedural, and interactional dimensions of justice are conceptually independent (Colquitt, 2001), there is little information as to whether these dimensions hold different structural positions in the broader motivational networks of the learners. Are the three dimensions of justice equally related to motivational engagement or are some (e.g., interactional justice) key bridges between the social-relational experiences and cognitive beliefs and behavioral intentions? Also, it is not clear whether the perceptions of justice are concentrated to a consistent fairness module independent of motivational constructs, or they are scattered across the motivational system. To answer these questions, analytical techniques are needed that can identify community structure, bridge relationships, and node-level influence that are the abilities that only network psychometrics can offer.

This study fills this gap by using network psychometrics to map how expectancy–value beliefs, achievement goals, L2 motivational selves, mindsets, language anxiety, and classroom justice perceptions are structurally interconnected among EFL learners. We estimate a regularized partial correlation network using an Extended Bayesian Information Criterion Graphical Least Absolute Shrinkage and Selection Operator (EBICglasso) approach of 434 Turkish undergraduate EFL students to answer seven research questions that test (1) the descriptive and reliability properties of the motivational-justice system, (2) the nature of the conditional association between the facets, (3) the identification of core nodes based on their strength and expected impact, (4) the mediation by the justice dimensions, (5) the formation of coherent subnetwork. Therefore, the following research questions were attempted to be answered:

RQ1. To what extent do Turkish undergraduate EFL learners exhibit adaptive motivational orientations (mastery goals, growth mindsets, ideal L2 selves) versus maladaptive patterns (avoidance goals, fixed mindsets, anxiety), and how do their perceptions of classroom justice align with these motivational profiles?

RQ2. How are classroom justice perceptions (distributive, procedural, interactional) structurally integrated within the broader motivational system of expectancy-value beliefs, achievement goals, L2 motivational selves, and mindsets?

RQ3. Which motivational and justice-related factors exert the strongest influence on learners' L2 engagement, and which factors function as inhibitors of adaptive motivation?

RQ4. Do classroom justice dimensions function as mediating bridges that link cognitive-affective beliefs (expectancy, value, anxiety) with behavioral engagement (intended effort), or do they operate as independent peripheral factors?

RQ5. How do motivational, cognitive, and justice-related processes organize into functionally distinct yet interdependent subsystems within learners' L2 motivational ecology?

RQ6. What differentiates the structural positioning of adaptive motivational factors (positive learning experiences, mastery goals, growth mindsets) from maladaptive factors (cost perceptions, anxiety, avoidance goals) in shaping learners' motivational dynamics?

RQ7. To what extent is the identified motivational-justice network architecture generalizable and stable across different subsamples of the learner population?

The theoretical framework used to ground the current study is shown in Fig. 1, which conceptualizes L2 motivation as a dynamic, signed system in which cognitive appraisals, self-related beliefs, goal orientations, affective states, and perceptions of classroom justice mutually reinforce or inhibit learner engagement. In line with Expectancy-Value-Cost theory, expectancy and value appraisals are theorized to positively predict intended effort, and perceived cost is theorized to negatively predict engagement directly and to positively predict anxiety, which is the affective burden of sustained language learning (Eccles & Wigfield, 2002; Wigfield & Eccles, 2020; Pekrun, 2006). Based on the Achievement Goal Theory, the mastery-oriented task goals are theorized to be positively correlated with effortful engagement, whereas the performance-avoidance goals are assumed to elevate anxiety and inhibit effort because of the emphasis on the error avoidance and the evaluative threat (Elliot & McGregor, 2001; Anderman & Wolters, 2006). In the L2 Motivational Self System, ideal L2 self imagery and positive learning experience are postulated to facilitate the intended effort via their motivational and affective mechanisms, whereas externally regulated ought-to selves are theorized to increase anxiety by creating controlling pressures and fear of negative appraisal (Dörnyei, 2009; Dörnyei, 2019; Papi, 2010). These pathways are further moderated by implicit theories of ability where growth mindset facilitates expectancy beliefs and mastery goals and suppresses fixed mindset orientations, which, in their turn, correlate with increased anxiety and decreased engagement (Dweck, 2006; Lou & Noels, 2019). Notably, the organizational justice theory is incorporated to place distributive, procedural, and interactional justice as social-relational controls of the motivational system, and fair grading, transparent procedures, and respectful interaction are expected to enhance adaptive motivational processes, perceived costs and anxiety, and promote mastery-oriented engagement (Colquitt, 2001; Tyler and Blader, 2003; Rasooli et al., 2019).

This study has three important contributions by incorporating motivation and justice in one empirically derived network. In theory, it builds on dynamic systems models of L2 motivation (Dörnyei et al., 2014) by showing how the perceptions of fairness are structurally integrated into the motivational ecologies of learners, which may serve as social scaffolding that facilitates cognitive-affective involvement. Theoretically, it is the first to use network psychometrics to the motivation-justice interface, and it offers a replicable model to future cross-cultural and longitudinal studies. In practice, central node identification, bridge connections, and cohesive clusters can be used to guide specific pedagogical interventions that imply, e.g., whether procedural transparency improvement or positive learning experiences can produce the most significant downstream implications on learner motivation.

2. Methods

2.1. Research design

We used a quantitative psychological network design to model the conditional associations among learners' expectancy-value beliefs, achievement goal orientations, mindsets, foreign-language motivation, anxiety, and classroom justice. In this framework, observed facets are represented as nodes and their regularized partial correlations (controlling for all other nodes) as edges, emphasizing mutual influence rather than reflective latent factors (Borsboom & Cramer, 2013). A Gaussian Graphical Model was estimated with the Extended Bayesian Information Criterion Graphical Least Absolute Shrinkage and Selection

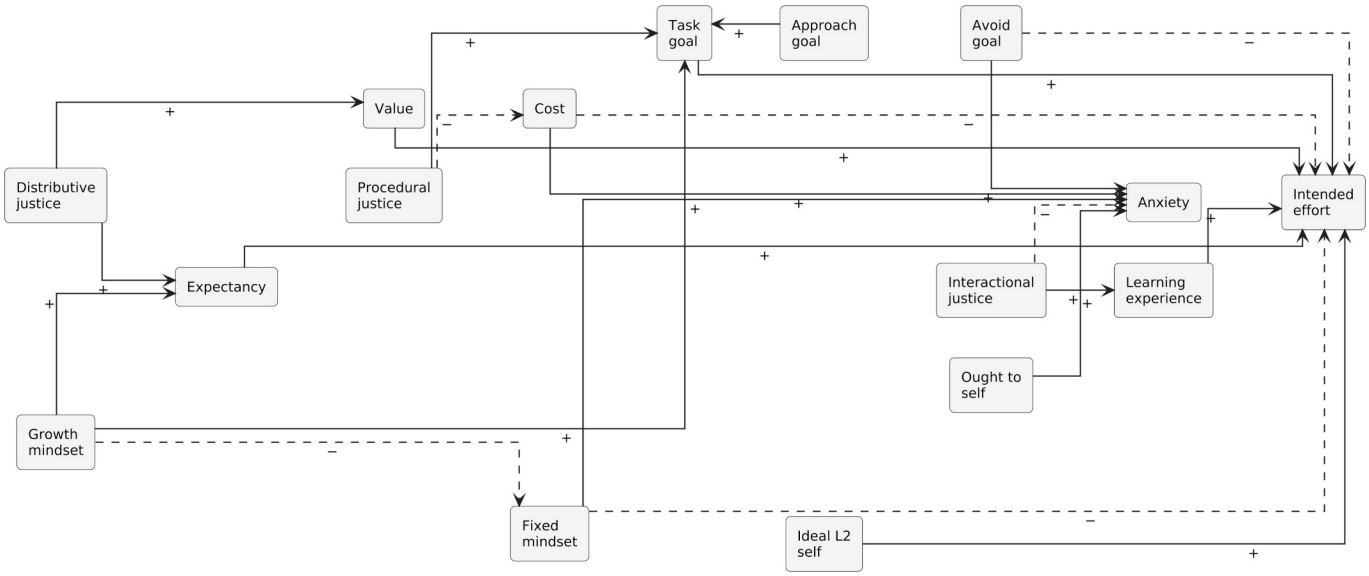

Fig. 1. Underpinning theoretical framework.

Operator-Based (EBICglasso) procedure, which yields a sparse, interpretable network by shrinking weak edges toward zero (Epskamp et al., 2018). To accommodate Likert-type non-normality, we used nonparanormal (npn) correlations. Inspection of transformed distributions confirmed that the non-paranormal procedure substantially reduced skewness and kurtosis for justice variables, supporting the robustness of partial correlations. Centrality (strength, expected influence) indexed relative importance of nodes (Costantini & Perugini, 2016). Robustness was assessed with nonparametric and case-dropping bootstraps (Robinaugh et al., 2016).

2.2. Participants and setting

Participants were recruited using convenience sampling from intact EFL classes at a single public university. Recruitment occurred via in-class announcements and an online survey link distributed to students who volunteered to participate. The final sample consisted of 434 (252 women (58.1%); 182 men (41.9%)) undergraduates enrolled in compulsory or elective English as a Foreign Language (EFL) courses at a large public university in Türkiye. Eligibility required being 18–30 years old, currently enrolled in an undergraduate EFL course, and providing informed consent. Participants were recruited via brief in-class announcements. Descriptively, the mean GPA was 3.24 (SD = 0.88) (on a 5 point scale: 1 = "below 2,0" to 5 = "3,5 - 4,0" out of 4); 28.1% reported having completed English preparatory school. Class standing skewed toward early years (median 2, modal 1), self-rated English level most commonly 3 (Intermediate (B1); on a 1–5 scale from Beginner (A1) to Advanced (C1-C2)), and the modal cumulative exposure to English instruction was "3–5 years."

2.3. Data collection and measures

2.3.1. Survey administration

The questionnaire was administered online (Google Forms). Blocks were randomized by construct and items were randomized within blocks. Two attention checks were included (one instructed-response, one simple logic item). Timestamps enabled screening for unrealistically short completions.

2.3.2. Measures and node operationalization

The unit of analysis in this study was the individual learner (N = 434). Facet-level mean scores for each construct were entered as nodes in the EBICglasso network [Supplementary Material 1]. Each node was computed as the mean of its constituent items. All instruments had well-established validity in motivational and educational psychology. Unless otherwise indicated, higher scores reflected more adaptive orientations toward learning, motivation, and justice perceptions.

Demographic Information Form. A brief demographic form accompanied the main scales to record participants' gender, GPA, preparatory school status, class year, self-rated English level, and years of English study.

The Achievement Goal Orientation Scale (Midgley et al., 1998) was made of 18 items evaluated on a 5-point scale that judged students' motives for academic work. Task/Mastery Goal Orientation items like, "I like schoolwork that I'll learn from, even if I make a lot of mistakes," pointed toward intrinsic motivation ranked on learning and improvement. Ability-Approach Goal Orientation ("I want to do better than other students in my classes") referred to the motivation to show others' superiority which is performance-driven. On the other hand, Ability-Avoid Goal Orientation ("An important reason I do my schoolwork is so that I don't embarrass myself") was based on the avoidance of negative judgments or failure. The mean of each subscale formed a single node in the network.

The L2 Motivational Self System (Papi, 2010) consisted of 24 items rated from 1 to 6, addressing how future self-concepts and personal experiences shape English learning motivation. The Ideal L2 Self facet (e.g., "I can imagine myself speaking English with international friends or colleagues") reflected students' internalized, aspirational images of themselves as competent English users. The Ought-to L2 Self ("If I fail to learn English, I'll be letting other people down") captured extrinsic motivation stemming from external expectations and social obligations. The English Learning Experience ("Do you find learning English really interesting?") indicated emotional engagement and enjoyment during classroom activities. The Intended Effort facet ("I would like to spend lots of time studying English") represented deliberate persistence and behavioral commitment to language learning. Each of the four subscales was entered as a separate node.

The English Anxiety Scale (Papi, 2010) included six items rated from 1 to 6 to measure tension and worry during English use. A representative item, "How nervous and confused do you get when you are speaking in your English class?", captured the affective costs of language learning that may interfere with performance. The average score across items represented the English Anxiety node.

The Mindset Scale (Dweck, 1999; Dweck et al., 1995) encompassed

eight items with a 6-point scale for measuring implicit theories of personal change. The Fixed Mindset subscale (for instance, "Each person is born with certain traits, and nothing can be done to change them") represented the belief in human traits that are inherent and thus unchangeable. The Growth Mindset subscale (for instance, "Everyone can eventually be different even in their most basic qualities," reverse-scored) was indicative of acceptance of human nature as being malleable and of the potential of improvement through effort and learning. The four-item method for each mindset dimension resulted in the separation of nodes.

Lastly, the *Teacher Classroom Justice Scale* (Estaji et al., 2023) measured the perceived fairness in classroom interactions with eighteen items on a 5-point frequency scale (1 = Never, 5 = Always). The Distributive Justice dimension ("I grade students based on their achievements") included the grading and awarding of points fairly as its main area of concern. The Procedural Justice dimension ("There are equal opportunities and time for all the students to participate in the discussions") was indicative of having open and fair decision-making practices. The Interactional Justice dimension ("I take into account my students' feelings, opinions and rights") showed that the teacher is respectful and empathetic in the case of students and that students have the same relationship with their teacher. Mean scores for each dimension were treated as separate nodes.

Expectancy–Value–Cost Light Scale is a brief self-report instrument grounded in expectancy–value theory and developed and validated by Schoeffel et al. (2022). The instrument, which was used to measure related to motivational aspects, consists of six items designed to assess three motivational components expectancy, value, and cost, each represented by two items. Expectancy captures students' confidence in learning course content and achieving success, value reflects students' perceptions of the usefulness and importance of the course for learning English, and cost refers to perceived effort, time demands, and sacrifices required by the course. Responses were collected using a five-point Likert-type scale ranging from strongly disagree to strongly agree. Subscale scores for expectancy, value, and cost, as well as an overall motivation index, were calculated in accordance with the EVC Light framework. The scale was selected due to its strong theoretical foundation, demonstrated reliability and construct validity in prior research, and its suitability for efficient data collection in educational settings.

In total, there were 16 facet-level nodes like Expectancy, Value, Cost, Task Goal, Ability-Approach, Ability-Avoid, Ideal L2 Self, Ought-to L2 Self, English Learning Experience, Intended Effort, English Anxiety, Fixed Mindset, Growth Mindset, Distributive Justice, Procedural Justice, and Interactional Justice which constituted the EBICglasso network as interrelated elements of students' motivational-justice system, reflecting the dynamic interconnections among cognitive, affective and fairness aspects of EFL learning.

2.4. Study procedure

The study followed a structured multi-phase procedure to ensure systematic, reliable data collection and analysis (Fig. 2).

Phase 1: Preparation and Ethical Clearance. Before data was collected, the institutional review board of the university gave the ethical approval. Access to course instructors was also obtained to invite students to attend the EFL sessions whenever there were scheduled classes. The linguistic comprehension and cultural suitability of all survey materials, including the participant demographics form, and blocks of instruments, were checked by two specialists in applied linguistics and an educational psychologist.

Phase 2: Pilot Study. To determine the clarity, timing and interface of the online questionnaire, a pilot test was carried out on 20 undergraduate EFL students. Two items were slightly modified in wording in order to improve understanding. The pilot test results were an average time of about 16 min and good reliability of all subscales ($\omega > 0.70$).

Phase 3: Main Data Collection. The primary survey was conducted online through Google Forms over a period of four weeks during the normal classes and using the Learning Management System of the university. Students were made to understand that the participation was voluntary and their responses would be anonymous. The survey was introduced with the consent page and then proceeded to the demographic questions and 5 randomized blocks of constructs Expectancy-Value-Cost, Goal Orientation, L2 Motivational Self System, Mindset, and Classroom Justice. To filter careless responses, attention checks (e.g., "Select 'Agree' to this item") were provided.

Phase 4: Cleaning and Scoring of Data. Data collection was followed by removal of the responses that did not pass both attention tests or those that took less than a third of the median response time. Facet scores at the node level were calculated by averaging the item responses of the corresponding node and reverse scoring was used where needed (e.g., Growth Mindset). The data sets of each participant were analyzed regarding the absence of missing data; since the online questionnaire demanded the answers to all questions, no imputation was needed.

Phase 5: Descriptive and Reliability Analysis. Each facet node was calculated using descriptive statistics (mean, standard deviation, skewness and kurtosis). The ω of McDonald was calculated to determine internal consistency and all were above.75 indicating that they were sufficient to be included in the network.

Phase 6: Network Estimation and validation. JASP (v.0.95.4) was used to estimate the EBICglasso network based on non-paranormal correlations to provide non-normal Likert data. The EBIC tuning parameter was set to $\gamma = 0.50$, reflecting the recommended balance between sensitivity and sparsity in psychological networks (Epskamp et al., 2018). Sensitivity analyses with $\gamma = 0.25$ and $\gamma = 0.75$ produced highly similar network structures (Spearman rank correlation of strength centrality $\geq$ 0.90 across γ values), indicating that conclusions were not dependent on

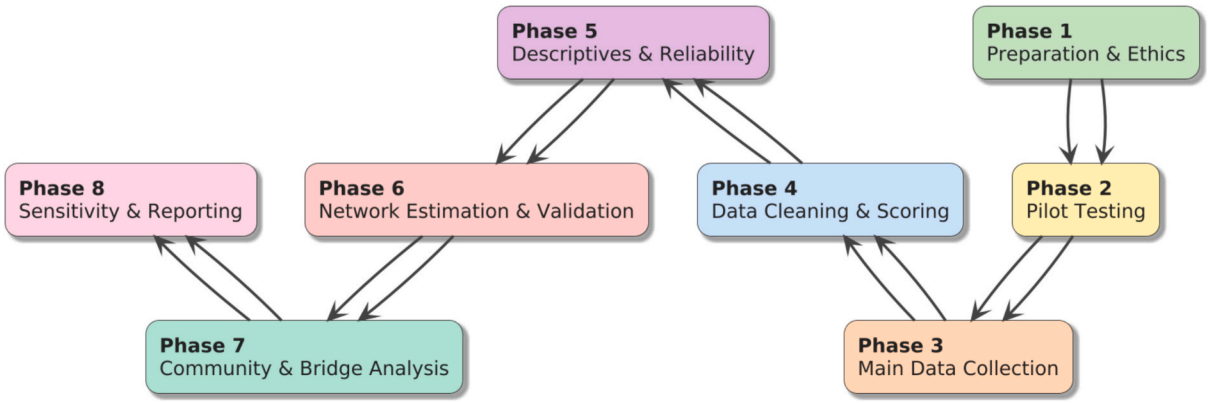

Fig. 2. Study procedure flowchart.

a specific regularization setting. A spring layout was used in visualization where edge color and thickness was used to indicate direction and strength of partial correlations. The bootstrapping of 5000 resamples was carried out to test the accuracy of edge-weight and stability of centrality. The strength and expected-influence indices were found to be robust by correlation-stability coefficients (CS $\geq$ 0.50).

Phase 7: Community Detection and Bridge Analysis. Eventually, the cohesive subnetworks in the motivational-justice system were found using exploratory Walktrap algorithms. The Walktrap algorithm was selected because it detects communities based on short random walks and performs reliably in weighted psychological networks. Alternative community detection using the Louvain algorithm yielded convergent module assignments for justice and motivational clusters, supporting the stability of the identified community structure. Bridge expected influence was tested on justice nodes which tested their ability as bridge between cognitive-motivational and affective-social elements. The stability of network topology and node hierarchy was checked by sensitivity analysis with g values of 0.25 and 0.75. This process brought methodological openness and repeatability of mapping the multifaceted interaction of motivation, mindset, goal orientation, and perceived justice in EFL learning conditions.

2.5. Data preparation and scoring

Prior to analysis, reverse-keyed items were recoded to ensure consistent directionality across all scales. Each facet (or node) score was computed as the mean of its constituent items to operationalize subscale-level constructs as the unit of analysis in the network. Sequential case-exclusion criteria were established to maintain data integrity: participants would have been removed if they failed both attention checks, exhibited extreme straight-lining, or completed the survey in less than one-third of the sample's median response time. However, none of the responses met these exclusion thresholds, so the full dataset (N = 434) was retained for analysis.

Descriptive statistics (M, SD, skewness, and kurtosis) and Shapiro-Wilk tests were conducted to examine the distributional properties of each node and to justify the use of robust correlation estimators. Internal consistency was evaluated using McDonald's ω, with an a priori threshold of ω $\geq$ 0.60 set for retention. All nodes exceeded this criterion, confirming adequate reliability for inclusion in network estimation.

2.6. Data analysis

All analyses were conducted in JASP (v.0.95.4) using the Network Analysis module. Non-paranormal correlations were estimated to reduce bias from Likert-scale non-normality, and the EBICglasso algorithm (γ = 0.50) was applied to estimate a sparse, weighted partial correlation network. A force-directed (spring) layout was used for visualization, where edge thickness indicated the magnitude of the partial correlation and color denoted direction (blue = positive, red = negative). Next, node centrality was examined through strength and expected influence, standardized to enable cross-node comparison. Community detection followed the Walktrap algorithm, and local clustering coefficients were computed to evaluate neighborhood cohesion. Bridge expected influence was also inspected to determine whether justice-related facets served as connectors between motivational and belief/goal subsystems. Finally, network accuracy and stability were assessed using 5000 nonparametric bootstrap resamples for edge-weight confidence intervals and case-dropping bootstraps to estimate correlation-stability coefficients. All indices met accepted thresholds (CS $\geq$ 0.50), confirming robustness. Sensitivity analyses with γ values of 0.25 and 0.75 yielded consistent network structure and centrality ranks, supporting the reliability of the final model.

2.7. Validity, reliability and robustness

The clarity of the items and their appropriateness to the Turkish EFL context were confirmed by a pilot study with 20 students. The reliability of the measurements was determined by using McDonald's ω for each node, where all the coefficients were above the minimum inclusion requirement (ω $\geq$ 0.60) thus indicating the internal consistency. The EVC-Light scale preserved its original three-facet structure (Expectancy, Value, Cost), and the multi-facet measures of Goal Orientation, L2 Motivational Self System, and Classroom Justice adhered to their validated subscale structures. Validation of the construct was through the measurements of reliability, distributional checks, and robustness diagnostics, including bootstrapped edge confidence intervals and centrality stability coefficients. The network structure demonstrated expected theoretical associations (e.g., Expectancy-Value, Learning Experience-Intended Effort) which showed the existence of nomological validity. Lastly, the performance of the robustness analyses using 5000 bootstrap resamples showed the stability of edge precision and centrality estimates (CS $\geq$ 0.50), thus confirming that the observed relations of the network were sound both statistically and theoretically.

2.8. Ethical considerations

The Iğdır University Institutional Ethics Review Board gave its approval for the research. The involvement was optional and based on electronic informed consent. Personal information such as names, IP addresses, or main identifying metadata was not gathered, and the responses were associated with anonymous IDs only. The participants had the option to leave at any moment without any consequences. The data was kept in digital files that were protected by passwords, and the access was only allowed for the research team. There was a debrief page that offered contacts for questions and support. Artificial intelligence tools (GPT-5.1 and Grammarly) were solely used for language editing, refinement and formatting purposes during review/editing process.

3. Results

The results are presented in three parts: descriptive statistics, reliability estimates, and network analyses addressing the study's research questions. Preliminary analyses examined the distributional properties and internal consistency of all 16 facet nodes to ensure data suitability for network estimation. Descriptive findings summarized in Table 1 provide an overview of Turkish undergraduate EFL learners' motivational, cognitive, and justice-related orientations.

The descriptive results in Table 1 indicated that Turkish

Table 1
Descriptive statistics of facet nodes.

Node	M	SD	Skewness	Kurtosis	Scale range
Expectancy	3.44	1.02	−0.40	0.08	1–5
Value	3.40	1.02	−0.46	−0.07	1–5
Cost	2.84	0.76	−0.17	0.81	1–5
Task Goal Orientation	3.56	0.99	−0.43	0.12	1–5
Ability-Approach Goal	3.48	0.98	−0.50	0.15	1–5
Ability-Avoid Goal	2.90	0.78	0.03	0.09	1–5
Ideal L2 Self	3.58	1.14	−0.18	−0.22	1–6
Ought-to L2 Self	3.54	0.87	−0.77	2.05	1–6
Learning Experience	3.59	1.17	−0.08	−0.25	1–6
Intended Effort	3.64	1.16	−0.07	−0.38	1–6
English Anxiety	3.22	0.96	0.41	0.80	1–6
Fixed Mindset	3.02	1.01	0.91	0.73	1–6
Growth Mindset	3.63	1.25	−1.26	0.66	1–6
Distributive Justice	4.17	0.69	−2.13	6.29	1–5
Procedural Justice	4.24	0.72	−2.33	6.93	1–5
Interactional Justice	4.28	0.70	−2.37	7.37	1–5

Note. N = 434. All Shapiro-Wilk $p < .001$. Distributions deviate from normality, justifying robust (Spearman/non-paranormal) correlations.

undergraduate EFL learners reported strong mastery-task orientation, positive English learning experiences, and high intended effort, which confirms an intrinsically motivated profile. Mindset indicators showed a dominant growth orientation (M = 3.63) and a relatively low fixed mindset (M = 3.02), which implied flexibility in beliefs about changeability. The moderate anxiety and cost scores (≈3) suggest that while learners value English and invest effort, they still experience occasional tension and workload pressure. Justice perceptions were extremely positive, as indicated by strong negative skew and high kurtosis, which is a typical ceiling effect in fairness research. Thus, we conducted sensitivity analyses to evaluate whether distributional artifacts influenced edge weights or centrality. In addition to the non-paranormal (npn) transformation used in the primary model, we re-estimated the network using (a) rank-based quantile transformation and (b) 5% winsorized justice nodes. Network topology, justice centrality ranks, and bridge expected influence values remained substantively unchanged ($\Delta z < 0.15$; edge differences < 0.04). These results indicated that skew and ceiling effects did not materially distort conditional associations.

Answering Research Question 1, the descriptive and reliability analyses presented a general picture of motivational, cognitive, and justice-related profile of learners and then estimated the network. Table 1 demonstrates that students have generally positive motivational orientations, characterized by high levels of intended effort, high levels of ideal L2 selves, and positive experiences of learning English. Negative skew and high kurtosis of justice perceptions were very positive, and these values are characteristic of ceiling effects in fairness research. Moderate anxiety and cost scores suggested that although learners were engaged, they still experienced some evaluative pressure. Reliability analyses in Table 2 confirmed acceptable to excellent internal consistency across all 16 constructs (ω = 0.76–0.94), ensuring that each node contributed stable variance to the subsequent EBICglasso estimation. Collectively, these results portrayed a sample characterized by intrinsic motivation, growth-oriented mindsets, and very high fairness perceptions in classroom interactions.

Given the mix of 5- and 6-point Likert ranges and non-normality observed in Table 1, the network analysis uses EBICglasso with non-paranormal correlations to ensure robustness. Yet, before moving with the analysis, we checked the reliability scores of the scales through McDonald's omega (Table 2).

In Table 2, internal consistency across all facets is satisfactory (ω = 0.76–0.94). High reliabilities for L2-motivation and justice nodes ensure stable variance for partial correlations. No node falls below the 0.60 threshold; thus, all 16 nodes were retained in the network estimation. The blend of moderate reliability and manageable inter-node correlations supports the use of regularized partial correlations rather than latent variable modeling.

Table 2
Reliability.

Construct	Items	ω	Decision
Expectancy	2	0.83	Acceptable
Value	2	0.80	Acceptable
Cost	2	0.76	Acceptable
Task Goal	6	0.88	Good
Ability-Approach	6	0.86	Good
Ability-Avoid	6	0.85	Good
Ideal L2 Self	6	0.93	Excellent
Ought-to L2 Self	6	0.89	Good
Learning Experience	6	0.92	Excellent
Intended Effort	6	0.94	Excellent
English Anxiety	6	0.91	Excellent
Fixed Mindset	4	0.82	Acceptable
Growth Mindset	4	0.84	Acceptable
Distributive Justice	4	0.85	Good
Procedural Justice	7	0.88	Good
Interactional Justice	7	0.90	Excellent

Note. All ω ≥ 0.75 → nodes retained for EBICglasso.

3.1. EBICglasso network analysis

We conducted the EBICglasso network analysis and the network structure was given in Table 3.

The EBICglasso network consisted of 16 nodes and 73 regularized edges (sparsity = 0.392), forming a moderately dense motivational system (Table 3). The regularized partial correlation network (EBICglasso, γ = 0.50) comprised 16 nodes and 73 non-zero edges out of 120 possible connections, yielding a sparsity index of 0.392 (Table 3). This indicates a moderately dense network in which motivational, cognitive, and justice-related facets are interlinked but not redundant. The strongest connections are summarized in Table 4.

As shown in Table 4, the strongest regularized partial correlations emerged within the justice subsystem, particularly between Procedural Justice and Interactional Justice (r = 0.53), followed by Distributive Justice with Procedural Justice (r = 0.36) and Interactional Justice (r = 0.35). These strong conditional associations indicate the structural coherence of classroom fairness perceptions as a social-relational domain. Within the motivational subsystem, robust edges appeared between Expectancy and Value (r = 0.38) and between Task Goal Orientation and Ability-Approach Goal Orientation (r = 0.31), indicating direct associations between these nodes after controlling for other nodes. Behaviorally oriented facets—Ideal L2 Self, English Learning Experience, and Intended Effort—formed another cohesive triad (r = 0.27–0.42). Negative associations appeared primarily between Fixed and Growth Mindset (r = −0.55) and between Cost and Intended Effort (r = −0.07).

Addressing Research Question 2, the partial-correlation network revealed a well-differentiated yet cohesive structure composed of three interrelated modules: a justice-fairness cluster, a motivational-affective cluster, and an expectancy-value cluster. The justice nodes (Procedural, Interactional, and Distributive Justice) showed the strongest interconnections (r = 0.53–0.36), confirming their conceptual unity. Because justice nodes were moderately intercorrelated (e.g., Procedural–Interactional r ≈ 0.53), we examined whether bridge effects reflected substantive positioning. First, we estimated partial correlations controlling for a general-justice composite (mean of the three justice facets). Interactional Justice retained positive bridge expected influence toward Intended Effort and Task Goal Orientation, indicating that its bridging role was not solely attributable to shared general justice variance.

The motivational triad of English Learning Experience, Ideal L2 Self, and Intended Effort (r = 0.34–0.42) formed another dense subsystem, while the Expectancy-Value pair (r = 0.38) anchored the cognitive belief component. Collectively, these clusters depict a balanced motivational-justice network in which fairness perceptions, motivational engagement, and confidence-value beliefs act as mutually reinforcing subsystems within learners' motivational ecology (Fig. 3).

3.2. Network

To identify the most influential facets in the motivational-justice system, centrality indices were examined for all 16 nodes (Table 5, Fig. 4). Centrality measures quantify the degree to which a node is directly and indirectly connected to other nodes, with *strength* and *expected influence* providing the most stable indicators in psychological networks.

Table 3
Summary of network structure.

Metric	Value
Number of nodes	16
Number of non-zero edges	73/120
Sparsity	0.392

Note. EBICglasso (γ = 0.50) with non-paranormal correlations. Sparsity = 1 − (density).

Table 4
Strongest partial correlations (edge weights) in the EBICglasso network.

Rank	Connected nodes	Edge weight (partial r)	Direction
1	Procedural Justice - Interactional Justice	0.530	Positive
2	Distributive Justice - Procedural Justice	0.360	Positive
3	Distributive Justice - Interactional Justice	0.345	Positive
4	English Learning Experience - Intended Effort	0.422	Positive
5	Ideal L2 Self - English Learning Experience	0.337	Positive
6	Ability-Approach Goal - Ability-Avoid Goal	0.205	Positive
7	Ability-Approach Goal - Task Goal Orientation	0.314	Positive
8	Ability-Avoid Goal - English Anxiety	0.261	Positive
9	Expectancy - Value	0.379	Positive
10	Ideal L2 Self - Intended Effort	0.275	Positive
11	Fixed Mindset - Growth Mindset	−0.554	Negative
12	Cost - Ability-Avoid Goal	0.200	Positive
13	Expectancy - Task Goal Orientation	0.227	Positive
14	Ought-to L2 Self - English Anxiety	0.180	Positive
15	Cost - Intended Effort	−0.069	Negative

Note. Values represent regularized partial correlations (EBICglasso, $\gamma = 0.50$). Positive edges (blue in Fig. 3) indicate direct positive associations after controlling for all other nodes; negative edges (red) represent inhibitory links. Only edges with $|r| \geq 0.18$ are listed for parsimony.

Addressing Research Question 3, the centrality analysis showed that Intended Effort held the highest strength (z = 2.04) and expected influence (z = 0.71), underscoring its central regulatory role in the motivational-justice system. Learners' self-reported willingness to invest effort functioned as the primary hub linking expectancy beliefs, positive learning experiences, and justice perceptions (Table 5; Fig. 3). Closely following were English Learning Experience (EI = 0.82), Ideal L2 Self (EI = 0.77), and Interactional Justice (EI = 0.75). Together, these nodes formed a motivational-affective-social core in which enjoyment, future self-imagery, and perceptions of respectful teacher behavior mutually reinforced one another. Nodes associated with negative motivational states, Cost, Fixed Mindset, and Ought-to L2 Self, showed negative expected influence values, indicating inhibitory functions that dampen network activation. Among them, Cost (EI = −0.73) emerged as the most suppressive node, confirming that perceived effort expenditure directly undermines engagement. In contrast, the justice facets, particularly Interactional and Procedural Justice, exerted moderate positive influence, suggesting that fairness perceptions help stabilize the broader motivational environment rather than acting as direct drivers of behavior. Overall, the centrality results position Intended Effort as the organizing force of the system, supported by affective enjoyment and social fairness cues that sustain learners' motivational engagement.

3.3. Clustering patterns

To probe the local cohesion among neighboring nodes, four clustering indices (Barrat, Onnela, Watts-Strogatz, Zhang) were computed (Table 6, Fig. 5. Two dense communities emerged:

Table 5
Centrality indices for each node (normalized scores).

Variable	Betweenness	Closeness	Strength	Expected influence
Intended Effort	0.09	0.61	2.04	0.71
English Learning Experience	−0.80	−0.08	0.27	0.82
Ideal L2 Self	−0.20	0.21	0.34	0.77
Interactional Justice	−0.90	−1.77	0.49	0.75
Procedural Justice	−0.80	−1.71	0.23	0.55
Value	−0.70	0.11	0.22	0.60
Ability-Approach Goal	2.77	1.98	−0.32	0.62
Task Goal Orientation	0.29	1.22	0.39	0.45
Distributive Justice	1.48	−1.12	−0.60	0.40
English Anxiety	0.29	0.36	0.85	0.03
Expectancy	−0.50	0.20	0.27	0.19
Growth Mindset	−0.30	−0.09	0.52	−2.73
Fixed Mindset	0.29	0.16	−0.14	−1.72
Ability-Avoid Goal	0.69	1.00	−0.57	−0.22
Ought-to L2 Self	−0.80	−0.36	−1.55	−0.48
Cost	−0.90	−0.71	−2.43	−0.73

Note. Values are normalized z-scores from the JASP network-analysis module. Bolded values represent the highest positive centralities in each column.

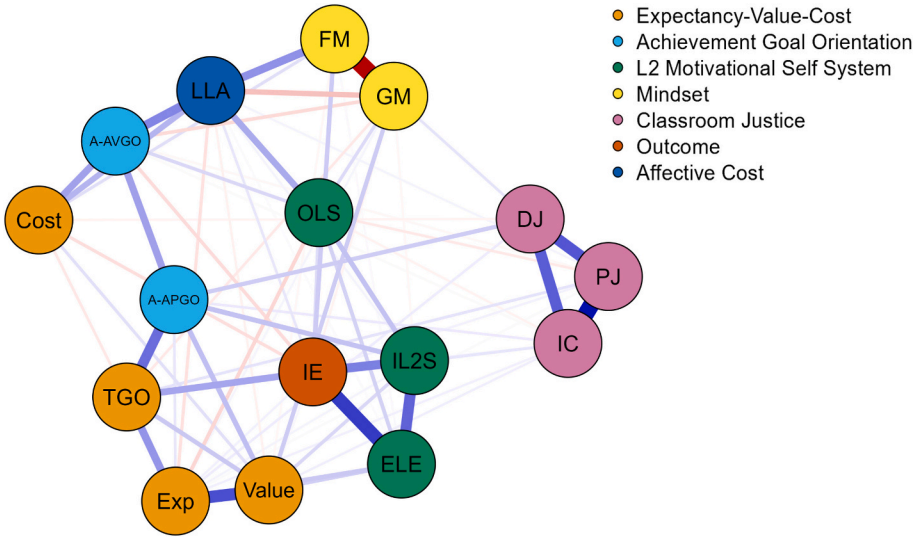

Fig. 3. EBICglasso network of L2 motivational system and classroom justice.
Note. Blue lines indicate positive relationship while red lines indicate negative relationship. The darker and thicker edges indicate stronger relationship. Labels: A-APGO = Ability-Approach Goal Orientation; A-AVGO = Ability-Avoid Goal Orientation; IL2S = Ideal L2 Self; Ought-to L2 Self = OLS; ELE = English Learning Experience; IE = Intended Effort; LLA = Language Learning Anxiety; FM = Fixed Mindset; GM = Growth Mindset; DJ = Distributive Justice; PJ = Procedural Justice; IJ = Interactional Justice. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

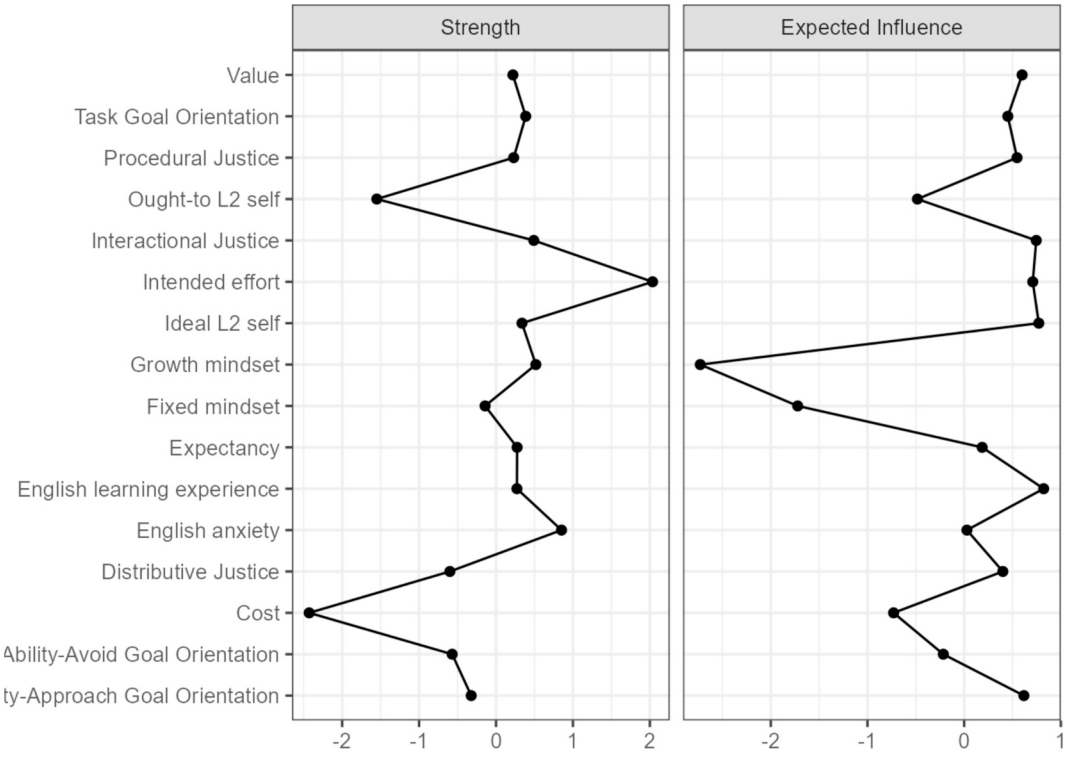

Fig. 4. Centrality plot.

Table 6
Clustering coefficients per node.

Variable	Barrat	Onnela	WS	Zhang
English Learning Experience	2.303	2.665	1.860	0.637
Fixed Mindset	1.389	1.420	1.372	−0.275
Ought-to L2 Self	1.090	0.326	0.965	−0.450
Ideal L2 Self	0.506	0.412	0.851	0.398
Task Goal Orientation	0.512	0.601	0.111	−0.789
Value	0.204	−0.370	−0.101	−0.581
Expectancy	0.105	−0.799	−0.070	−0.646
English Anxiety	−0.080	−0.180	0.086	−0.419
Intended Effort	−0.477	−0.807	−0.129	−0.429
Cost	−0.497	−0.445	−1.068	−0.235
Ability-Approach Goal Orientation	−0.726	0.708	−0.092	−1.089
Ability-Avoid Goal Orientation	−1.174	−1.020	−1.027	−0.855
Growth Mindset	−1.017	−0.808	−0.515	−0.638
Distributive Justice	−1.485	−0.084	−2.336	2.301
Procedural Justice	−0.037	−0.615	0.152	1.669
Interactional Justice	−0.616	−1.005	−0.059	1.400

Note. Coefficients are standardized (z-scores). Higher positive values indicate stronger local interconnectedness among a node's immediate neighbors. Bolded values denote relatively high clustering coefficients across indices.

1. The Justice Cluster, composed of *Distributive*, *Procedural*, and *Interactional Justice*, demonstrated high Zhang coefficients (1.40–2.30), confirming strong reciprocal reinforcement among fairness perceptions. These three nodes form a stable *social-relational subsystem* that anchors learners' sense of equity and respect.
2. The Motivational-Affective Cluster, including *English Learning Experience*, *Ideal L2 Self*, and *Intended Effort*, showed the highest Barrat and Onnela coefficients (2.30–2.67). This indicates a tightly woven triad in which enjoyment and future self-imagery jointly amplify sustained effort.

On the other hand, the nodes like Cost, Fixed Mindset and Ability-Avoid Goal Orientation had low or negative clustering values meaning that they were not part of the primary motivational loop. The fact that they show limited local cohesion implies that maladaptive beliefs and avoidance tendencies only have an influence on them having an inhibitory, not a reinforcing, relationship.

All in all, the centrality and clustering results indicate a dual-community structure: a justice-fairness structure and a motivational-affective structure connected by integrative nodes like Interactional Justice and Task Goal Orientation. This arrangement emphasizes the fact that perception of fairness offers the social scaffolding on which individual motivation, fueled by positive learning experiences and self-guides to the future, can thrive in EFL situations. These clustering findings respond to Research Question 4, which in turn affirms that the justice dimensions, especially Interactional and Procedural Justice are mediators between cognitive-social beliefs and motivational involvement. Interactional Justice also had perceptions of fairness related with Intended Effort and Task Goal Orientation whereas Procedural Justice had perceptions of fairness related with transparent classroom processes associated with goal regulation. Despite being slightly peripheral, Distributive Justice strengthened the climate of fairness, making the sense of equity and respect among the learners stable. All these results suggest that justice is not a solitary moral phenomenon, but rather a social fabric that holds together belief, affect and effort systems.

In order to further investigate how the motivational-justice network is structured, we studied local clustering coefficients through four complementary algorithms (Barrat, Onnela, Watts-Strogatz and Zhang). Clustering coefficients measure how closely the immediate neighbors of each node are connected, thereby showing local communities in the larger network (Epskamp et al., 2018). Table 6 illustrates the standardized (z-score) coefficients of all the 16 nodes.

In reference to Research Question 5, as presented in Table 6 and as shown in Fig. 5, the clustering analyses revealed two cohesive subnetworks that define the structural organization of the motivational ecology of the learners. Two very cohesive subnetworks were formed. In the first place, the justice cluster, Distributive, Procedural, and Interactional Justice, exhibited a high level of clustering throughout the Zhang index (1.40–2.30), which signifies that there were strong local interconnections between the dimensions of fairness. This implies that

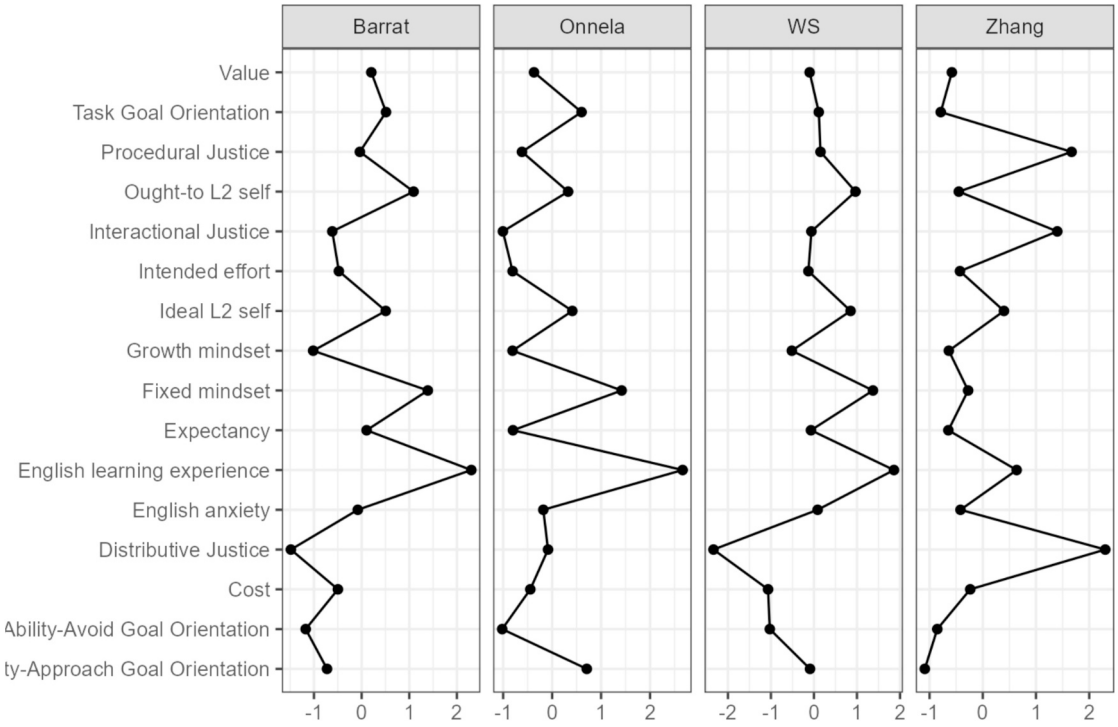

Fig. 5. Clustering plot.

the perception of students regarding equitable grading, procedural transparency, and respectful interaction co-exist and support each other, creating a stable social-relational module in the classroom setting. Second, the motivational-affective group included English Learning Experience, Ideal L2 Self, and Intended Effort. These nodes showed high clustering on Barrat and Onnela measures (2.30–2.67) indicating a strongly knit triad of enjoyment, self-imagery, and behavioral engagement. In this triad, English Learning Experience was the most dense local centre, suggesting that the positive affective experiences in the classroom held the belief-based and effort-based elements of motivation. In comparison, the nodes like Cost, Growth Mindset, and Ability-Avoid Goal Orientation showed low or negative clustering values across indices indicating relative isolation and low neighborhood cohesion. These results suggest that the perceived effort cost, rigid ability beliefs and avoidance motives are largely independent of the cooperative motivational dynamics within the network. On the whole, the clustering findings indicate that there is a system that is structured around two overlapping communities (justice and motivational-affective engagement) that are linked through the intermediate nodes (Interactional Justice and Task Goal Orientation). The model is supported by this structure where the perceptions of fairness stabilize the social environment and positive learning experiences maintain individual motivation, which collectively increases the involvement of learners in EFL contexts.

The answer to Research Question 6, nodes with low or negative clustering coefficients, including Cost, Growth Mindset, and Ability-Avoid Goal Orientation, exhibited weak neighborhood cohesion and relative isolation of the cooperative motivational loops of the network. These maladaptive aspects were mainly inhibitory based as opposed to reinforcing based, which means that perceptions of overworking, belief in fixed ability, and avoidance motivation decrease integration with the larger motivational-justice system. On the other hand, nodes with high clustering, especially English Learning Experience, Ideal L2 Self and Intended Effort, exhibited tight local interconnections that facilitate adaptive motivational processes. This tendency shows a structural polarity between integrative, growth-related motivation and disintegrative, defensive dispositions in the psychological structure of learners.

3.4. Bootstrap accuracy and stability

The accuracy and robustness of the estimated EBICglasso network were assessed through nonparametric bootstrapping with 5000 resamples (Epskamp et al., 2018). Bootstrapping provides confidence intervals (CIs) around edge weights and evaluates whether the identified network structure is stable under random perturbations of the sample. Regarding edge stability of the network, the bootstrapped edge-weight accuracy plot is given in Fig. 6.

Fig. 6 demonstrated narrow confidence intervals for the strongest positive edges, particularly among the three justice nodes (*Procedural-Interactional-Distributive Justice*, r = 0.35–0.53) and the motivational triad (*English Learning Experience-Ideal L2 Self-Intended Effort*, r = 0.27–0.42). These edges showed minimal overlap of confidence intervals with zero, indicating that they are highly robust connections. In contrast, weaker links (e.g., *Cost-Effort*, *Ought-to L2 Self-Anxiety*) exhibited wider CIs, suggesting greater sampling variability. Overall, the majority of moderate-to-strong edges remained stable across resamples, supporting the reliability of the network topology.

Next, the centrality stability (Fig. 7) was examined using case-dropping bootstrapping (5000 resamples), where subsets of participants were repeatedly removed to test the reproducibility of node centrality indices. Correlation-stability coefficients (CS) were calculated for both *strength* and *expected influence*. The CS coefficients for both metrics exceeded the recommended threshold of 0.50, indicating acceptable to high stability.

Therefore, regarding *Research Question 7*, bootstrap analyses verified that the observed topology and centrality hierarchy are statistically stable (Fig. 7). Non-parametric bootstrapping produced narrow confidence intervals for the strongest justice and motivational edges, while case-dropping bootstraps yielded correlation-stability coefficients above 0.50 for both strength and expected influence. These results demonstrated that the network's architecture and influential nodes were robust to sampling variability, lending confidence to the interpretability of the justice-motivation interconnections.

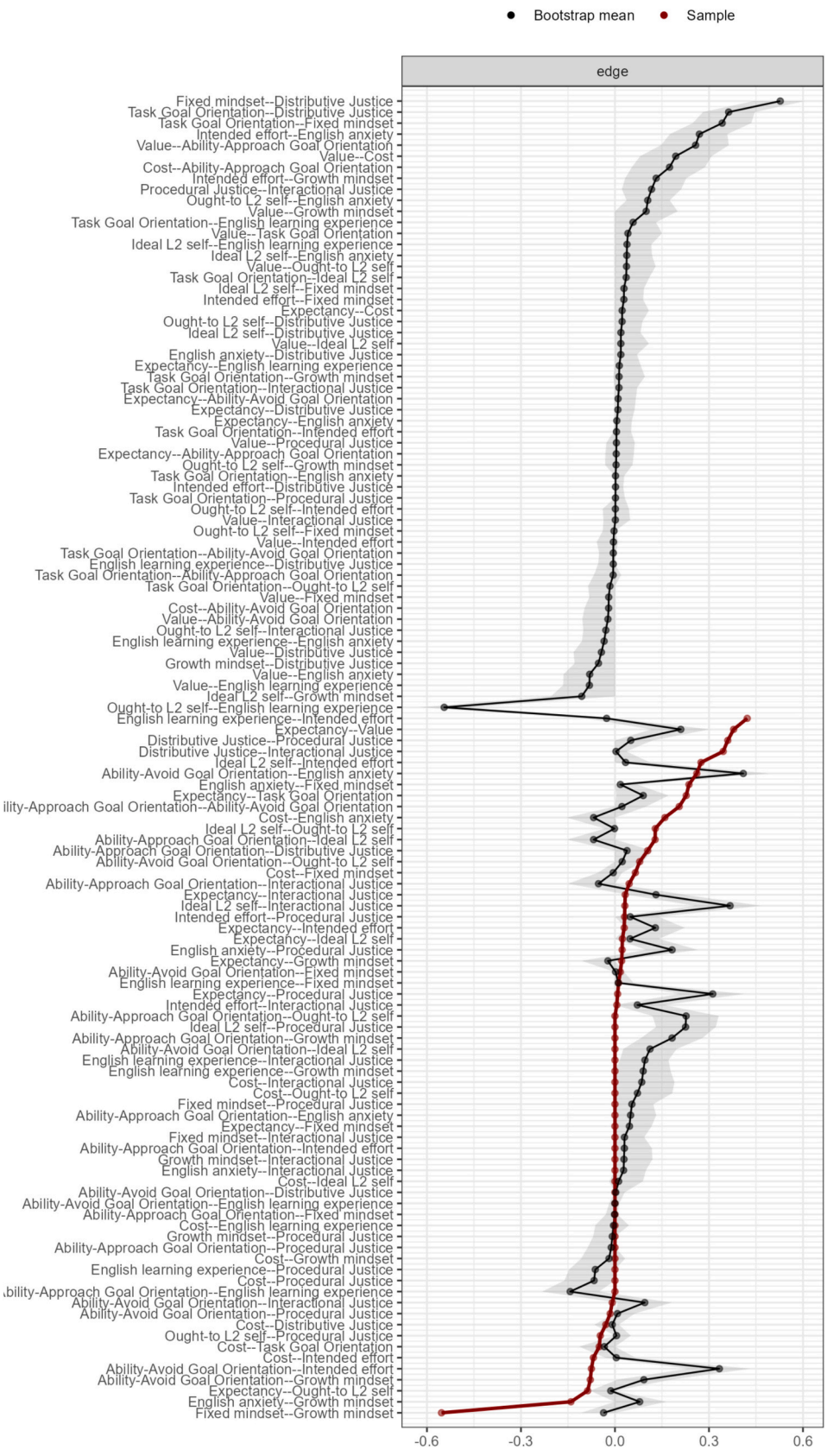

Fig. 6. Edge stability plot.

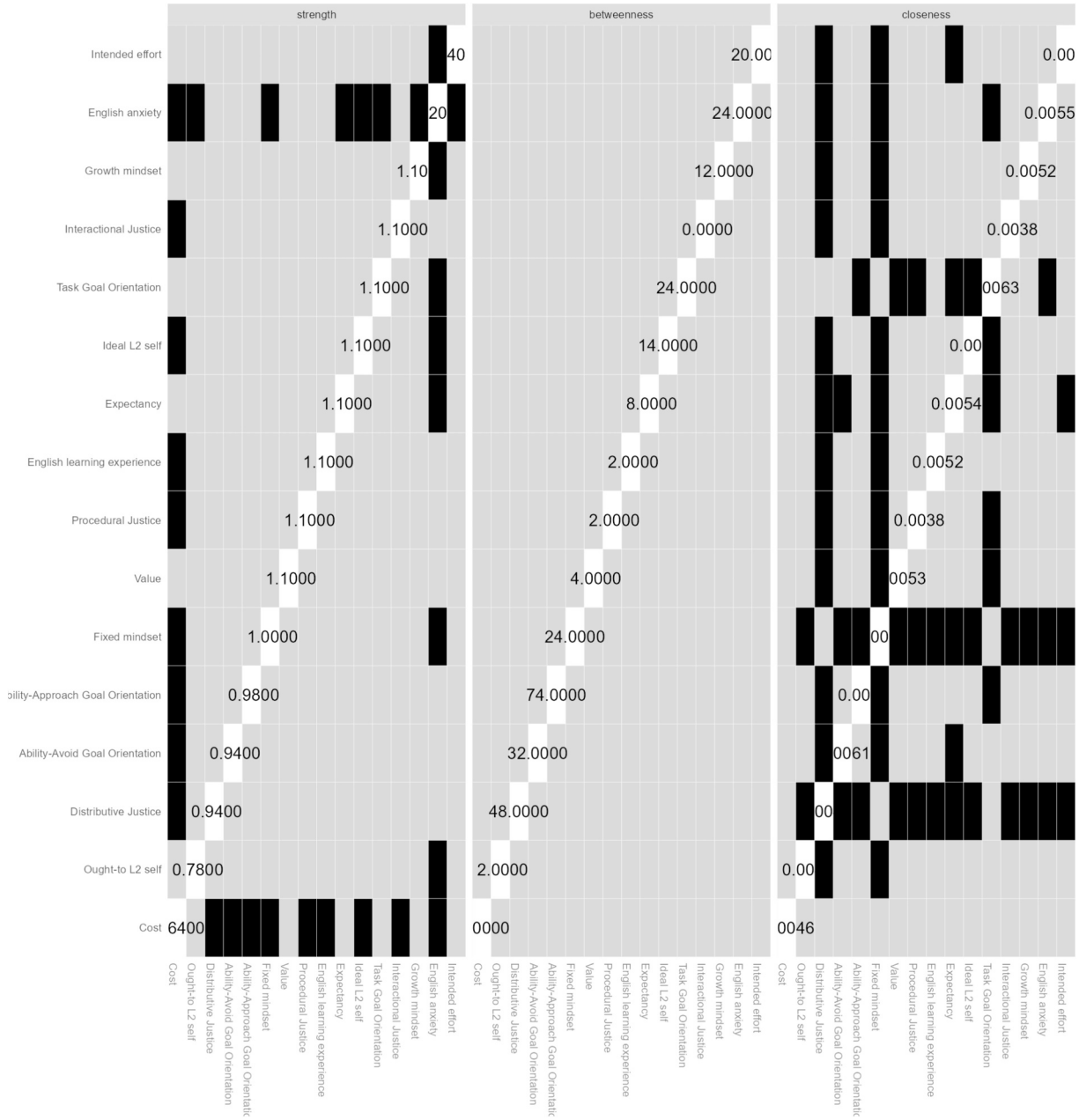

Fig. 7. Centrality stability with 5000 bootstrapped resamples.

4. Discussion

In line with theoretical advancements in educational psychology in SLA that conceptualize motivation as a dynamic, interconnected system rather than isolated traits (Dörnyei & Ryan, 2015; Hiver et al., 2024), this study employed network psychometrics to explore the interplay among expectancy-value beliefs, achievement goals, L2 motivational selves, mindsets, anxiety, and classroom justice in 434 Turkish undergraduate EFL learners. The regularized partial correlation network through EBICglasso illuminated how justice perceptions, encompassing distributive, procedural, and interactional dimensions (Greenberg, 1987; Colquitt, 2001), are embedded within learners' motivational ecologies, functioning as social scaffolding that stabilizes cognitive-affective processes rather than acting as independent predictors (Rasooli et al., 2019). This has addressed key research gaps by integrating justice and motivation domains, which have historically been studied in isolation (Molinari & Mameli, 2018), and by shifting from latent variable models like SEM to a network approach that reveals reciprocal associations among specific facets (Borsboom & Cramer, 2013; Epskamp & Fried, 2018).

The network had a two-community structure that is comparable to the multidimensional perspective of motivation in SLA (Dörnyei, 2009). The former community was made of aspects of justice (Distributive, Procedural, Interactional; r = 0.35–0.53) which is a dimension of motivation that influences the degree to which learners interact and perform in circumstances where there is fair treatment. The theory of organizational justice is extended to L2 in this work, where this also has an impact on performance (Chory, 2023; Chory-Assad & Paulsel, 2004). The second community included English Learning Experience, Ideal L2 Self and Intended Effort (r = 0.27–0.42). These dimensions are interrelated, supporting the L2 Motivational Self System (L2MSS) and Expectancy-Value-Cost (EVC) frameworks, as positive present learning experiences and future self-imagery appear to reinforce behavioral commitment (Dörnyei, 2005; Wigfield & Eccles, 2020). Interactional

Justice and Task Goal Orientation are bridges that connect communities, involve fair treatment, value mastery-oriented engagement, and psychological safety in teacher-student relationships, and map to self-determination theory and achievement goal theory (Deci & Ryan, 2000; Elliot & McGregor, 2001).

Considering centrality measures, Intended Effort was found to be the most influential node (z strength = 2.04; EI = 0.71) because it was a combination of the expectancy beliefs, affective experiences, and perceptions of justice in escalating persistence and is consistent with the EVC theory that highlights the effects of expectancy and value and downplays the effect of costs as drivers of behavior change (Eccles & Wigfield, 2020). The centrality of situated affect and aspirational self-concepts to L2 motivation was further highlighted by other high influence nodes, including English Learning Experience (EI = 0.82) and Ideal L2 Self (EI = 0.77) (Dörnyei, 2019), and the strong location of Interactional Justice (EI = 0.75) indicated that it may support intrinsic motivation. The nodes that exhibited maladaptive effects like Cost (EI = −0.73), Fixed Mindset (EI = −1.72) and Ought-to L2 Self (EI = −0.48) were also aligned with the literature that places costs as dampening factors, fixed mindsets as amplifiers of perceived threat and ought-to selves as anxiety based when controlling (Pekrun, 2006; Dweck, 2006).

Interactional and Procedural Justice emerged as bridge nodes linking social-relational factors with motivational processes, while also helping to stabilize the system by reducing uncertainty and defensiveness (Tyler & Blader, 2003). This promotes justice as a controller (and not an initiator, which encourages mastery ambitions and effort and reduces anxiety and avoidance, which is comparable to the literature that unfairness interferes with motivational pathways (Chory-Assad, 2002). The peripheral Distributive Justice strengthened the fairness climate, which is in line with multidimensional justice in education models (Colquitt, 2001).

The finding that the English Learning Experience node was highly clustered (Barrat = 2.30; Onnela = 2.67) indicates that it was an emotional connector to tie Ideal L2 Self and Intended Effort nodes together and at the same time propose a positive experience that triggered emotional synergies needed to get motivated (Dörnyei, 2009). The Maladaptive nodes (i.e., Cost, Fixed Mindset) exhibited isolation which indicates the high probability that such defensive mechanisms of adaptive motivation are underway without any reinforcing loops, likely because of the contextual evaluative norming of the Turkish EFL environment (Dweck et al., 1995). This is specifically relevant to the analysis of evolutionary tendency, but more specifically, the implications have proposed adaptive motivation as an integrated system that eventually guides a gap in the understanding of multi-facet heterogeneity beyond latent modeling (Borsboom & Cramer, 2013). Using network psychometrics, the research contributes to the dynamism systems models in SLA that justice is an internal element of motivational ecologies, and not an external moderator (Dörnyei et al., 2014). It reveals the subtleties that are hidden in SEM, including central integration of Ideal L2 Self and the periphery of Ought-to L2 Self, and locates intervention points such as central nodes of downstream effects (Epskamp & Fried, 2018).

Though this study offers important insights, several limitations should be noted. First, the cross-sectional design precludes causal inferences about directionality; future experimental and longitudinal research could test whether targeted classroom interventions—such as strengthening learning experience, procedural transparency (e.g., clear rubrics, advance criteria, structured feedback), and interactional-justice practices (e.g., respectful communication, equitable participation, validation of student voice)—produce measurable pre–post changes in network structure (e.g., increased centrality of Intended Effort or reduced salience of Cost). Second, reliance on self-report measures may introduce common-method bias; although the instruments showed strong psychometric performance and regularized partial correlations reduce spurious links, future work should triangulate results using behavioral indicators, teacher reports, observations, or experience sampling. Third, participants were recruited via convenience sampling from a single Turkish university, which may limit representativeness and external validity; therefore, the generalizability of the network structure should be interpreted cautiously and tested through multi-institutional and cross-cultural replications, ideally with longitudinal designs and invariance testing, and larger samples could enable item-level networks to probe micro-structural heterogeneity. Finally, the sample combined compulsory and elective EFL courses, and elective enrollment may reflect self-selection into different motivational profiles; future studies should examine course type explicitly (e.g., subgroup networks, moderated models, or invariance testing) to assess whether the motivational–justice architecture and the structural positioning of justice differ by enrollment status.

5. Conclusion

The current research made a contribution to the field of L2 motivation by incorporating the perceptions of classroom justice in a dynamic network model into a framework, which showed the architecture of expectancy-value beliefs, achievement goals, mindsets, L2 motivational selves, anxiety, and fairness dimensions as interconnected among Turkish undergraduate EFL learners. The EBICglasso system analysis revealed a medium-density system with two main communities: a highly interconnected justice community (distributive, procedural, and interactional justice) that offered social-relational scaffolding and a motivational-affective community (English learning experience, ideal L2 self, and intended effort) that propelled engagement and persistence. The most central node was intended effort, which had a significant role because it connects cognitive beliefs, affective enjoyment, and perceptions of fairness, and the maladaptive aspect of cost, fixed mindset, and ought-to L2 self are the inhibitors. The dimensions of justice, especially the interactional and procedural justice acted as mediators that stabilize motivational processes and the avoidance tendencies.

The network structure identified in this study suggests several justice-informed pedagogical implications for L2 classrooms, framed as practices that are consistent with the observed conditional-association. First, because Intended Effort occupied a highly connected position in the network and Interactional Justice showed comparatively strong structural connectivity, classroom practice can reasonably prioritize interactional justice routines (e.g., respectful and consistent teacher talk, equitable participation structures, timely and constructive feedback, and opportunities for student voice) alongside procedural justice routines (e.g., transparent assessment criteria, consistent grading rubrics, and clearly communicated decision rules). Second, because English Learning Experience, Ideal L2 Self, and Intended Effort cluster tightly in the network, instructors can treat these as a coherent “engagement bundle” when designing lessons. Practically, this means building each unit around (a) at least one authentic communicative task (e.g., a short interview, mini-project, or problem-solving discussion), (b) a brief future-self linkage prompt (e.g., “Where would you use this English in your future studies/career?”), and (c) a 2–3 min end-of-lesson reflection log connecting today's activity to that future use (one sentence + one action plan). Third, Cost and Fixed Mindset were comparatively less integrated with the main cohesive clusters, instructors can treat these as “peripheral risk signals” and design classroom routines that reduce uncertainty and ambiguity. Practically, this can be done by using predictable lesson structures (clear agenda and time expectations), transparent task criteria (what counts as a good response), and respectful interaction norms (consistent feedback language, equitable turn-taking), while monitoring cost-related signals through brief check-ins (e.g., a 1–2 item workload/effort rating) to identify when perceived burden or rigid beliefs become more salient in a given group.

Finally, at the institutional level, the prominence of justice clustering supports the relevance of systematic attention to fairness climate, including professional development focused on justice-informed classroom interaction, periodic review of assessment practices for transparency and consistency, and efforts to ensure equitable access to

learning resources; future research can evaluate the generalizability of these implications by testing whether similar network structures replicate across settings and by examining whether network architecture differs across course types, proficiency levels, or cultural contexts.

Abbreviations

A-APGO	Ability-Approach Goal Orientation
A-AVGO	Ability-Avoid Goal Orientation
IL2S	Ideal L2 Self
Ought-to L2 self	
ELE	English learning experience
IE	Intended effort
LLA	Language learning anxiety
FM	Fixed mindset
GM	Growth mindset
DJ	Distributive Justice
PJ	Procedural Justice
IJ	Interactional Justice

CRediT authorship contribution statement

Ferdi Çelik: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Volkan Duran:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Samantha Curle:** Writing – review & editing, Writing – original draft, Validation, Conceptualization.

Consent to publish

Participants signed informed consent regarding publication.

Ethical approval and consent to participate

This study adhered to the ethical principles of Declaration of Helsinki. The research was approved by the Iğdır University Research Ethics Committee (No: 2025/39). Informed consent was obtained from all participants included in the study.

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Declaration of competing interest

The authors of this study declare they do not have any competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2026.106846.

Data availability

Data will be made available on request.

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