Guessing the Game: An Individual's Awareness and Assessment of a Game's Existence

Katarina Kostelic

Faculty of Economics and Tourism "Dr. Mijo Mirkovic", Juraj Dobrila University of Pula, 52100 Pula, Croatia;
katarina.kostelic@unipu.hr

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Abstract: In everyday life, games begin inconspicuously, leaving an individual to stumble upon their assessment of a situation. An unaware individual is unlikely to exhibit strategic behavior in a given situation, which highlights the importance of awareness examination. The purpose of this exploratory analysis is to examine awareness and assessment of a game's existence at the individual level. That requires examination of respondents' detection (as an indication of their awareness) and identification (as an indication of their assessment) of game elements in game-like situations and their relation to awareness of the game existence. The empirical data is collected using a scenario technique and is statistically analyzed. The results show that the respondents are, on average, at least partially aware of possibility for strategic interaction (even in vague situations). The revealed regularities point out to the relation of the game elements to game existence belief, but also indicate the presence of psychological biases and information utilization issues. For example, the respondents assign different levels of belief to game existence regarding possible losses or gains. Research limitations involve the use of a small convenience sample and lead to suggestions for results validation in future research. Possible implications of the results are discussed.

Keywords: game awareness; behavioral game theory; individual; belief

1. Introduction

In everyday life, games do not follow standard game theory procedure, with all assumptions predefined; instead, they begin covertly, leaving an individual to assess what is happening. This leads to the very important game theory assumption, which is implicitly assumed and often not particularly isolated—awareness of the game. Halpern and Rego [1] argue that the flaw of standard game representation is that it implicitly assumes that the modeler and the players all understand the game the same way, that is, the game elements are common knowledge. In order to play a strategic game, players ought to be aware that they are playing a game. Such a necessity, as well as lack of awareness, is narrowly tied to another game theory assumption: interaction.

Interaction requires communication, which can be intended and unintended [2] and can have intended and unintended consequences as well. In addition, individuals can make mistakes in perceiving and interpreting the communication signals received from others. This means that individuals can be part of a game without knowing it, as well as believe that there is a game in process when there is none. Such situations can occur for an individual in everyday life, regarding interactions with partners, friends, coworkers, or in business, economic and law interactions, etc. Many of those examples can be observed as game-like situations. Insights into individuals' awareness in everyday game-like situations can be used to enhance modeling of individual assessment of the situations, and consequently, their strategic behavior.

Individual awareness and assessment of a game's existence relate to the fields of situational awareness, unawareness, and a 'pre-game' theory. Salmon et al. [3] examine definitions of situational

awareness, Bazerman and Chugh [4] and Chugh and Bazerman [5] offer definitions of bounded awareness, and Blasch et al. [6] review situation awareness in game theory, while most of the empirical research in the area focuses on threat awareness, in-game assessment, and prediction, with an emphasis on the application in the security field and the gaming industry [7–10]. Halpern and Rego [1,11–13] examine modeling unawareness regarding the language, knowledge, probabilities assignment, extensive games, action choice, and solutions.

Most of the existing research focuses on the (un)awareness and outcome prediction in an ongoing game and not the player's belief about a game's existence. It is important to notice the distinction: once the individual is aware of an ongoing game, s/he might focus their efforts on recognizing and perceiving game elements and potential threats; while awareness of the game represents an individual's ability to determine whether a game or game elements exist in the first place. To explore the awareness and assessment of the game-like situations at an individual level, a scenario technique is employed. For example, an individual is going to the shop to buy their usual groceries. Besides the usual shopping list, s/he intends to buy a favorite chocolate. When s/he arrives to the shell with the chocolates, they learn that the chocolate's price increased. In this situation, a price increase can be detected as an action. While the party that initiated this activity is not explicitly stated, an individual could guess based on common knowledge that it could be the shop manager, supplier, manufacturer, or government (through taxes). Most scenarios are open-ended, meaning that the actions of the respondent are not offered in the scenario. The reason for this is that the awareness and assessment of the game's existence precede the individual's assessment of their own possible and feasible actions. Possible immediate outcomes for the individual are the loss in case of a purchase or the lack of satisfaction from chocolate in the case of a non-purchase. That is merely a purchase decision, without any observable strategic implications. So, based on the respondent's awareness and assessment of a situation, it can be perceived as a game or as not being a game. Only if an individual assesses that there is a possibility of strategic interaction it would make sense to put effort into examination of their own set of possible and feasible strategies/actions. In this example, if an individual believes it is a strategic interaction, they may decide to play the game and to choose their own action that would lead to a preferable outcome. Besides the immediate purchase action choice, the individual might choose not to purchase that brand of chocolate until the price drops. The underlying strategy of such a choice is a presumed decline in demand, which would force the other player to reduce the price. If taken to an extreme, individual may, for example, choose to form or join an association for consumer protections and bargain for a reduction in the price of the chocolate. But that is possible only if an individual previously assessed the situation as strategic, like a game. If an individual is not aware of the game-like situation, then it is not likely that s/he will employ a strategy. A game-unaware individual is almost like a passive player in a dictator-like game. The "player" unaware of the game will most likely not exhibit strategic behavior, while a partially aware "player" might exhibit a skewed assessment and strategic behavior that deviates from optimal behavior. Therefore, an exploratory empirical research of awareness is necessary.

The purpose of this research is to examine individual awareness of a game's existence and assessment of game elements. The empirical data, gathered using a scenario technique, is used to provide insights into an individual's use of awareness and assessment of game elements and assigned beliefs to obtain answers about game elements regarding contextually different (everyday) situations. The analysis is focused on the quantification of self-reported detection, identification, and beliefs in game elements and the game's existence. Insights into individual awareness in everyday game-like situations enable deeper understanding of an individual's awareness and assessment of interaction situations, which can influence their outcomes/payoffs.

The theoretical framework section examines awareness and the formation of a belief assigned to a game's existence and offers an assessment of game presumptions on a personal level under incomplete information and uncertainty. The next section examines game existence awareness using a scenario technique and offers results and interpretation of statistical analysis. The conclusion section summarizes the results, discusses the implications, and offers proposals for further research.

2. Theoretical Framework

2.1. Awareness and Forming a Belief Assigned to a Game's Existence: A Literature Review

According to Camerer, Ho, and Chong [14], in a standard equilibrium analysis, every player forms his or her belief based on the analysis of what the other players can do; players choose the best responses given their beliefs, adapt their responses, and update beliefs until they achieve equilibrium. To form a game theory model, there must be: a strategic interaction; at least two players for which the choice of actions of least one of them should imply the presence of a strategy; and there must exist two or more possible outcomes shaped by players' choices. Basic game elements and presumptions must be satisfied for a game to exist. Hence, the existence of those elements and presumptions should be a threshold for determining whether the game exists.

The individuals may misinterpret a situation: individuals can either be a part of a game without knowing it, or there is no game, but one believes there is. The first option has strategic importance regarding the outcome. To paraphrase Harsanyi [15], the lack of action is also an action in itself, and the probability that an unaware player's lack of actions will result in a preferable outcome is very small. In order to assess individual awareness and assessment of a game existence, it is necessary to examine the (un)awareness framework.

Salmon et al. [3] systematize the most frequently used models of awareness. Smith and Hancocks' Perceptual cycle model of situation awareness is general enough to be used prior to the game, and reflects the information retrieved from the environment and the influence of cognitive features, and has an action as a result. Chen et al. [16]'s approach to defining unawareness as "a real-life phenomenon associated with an unconscious mental state directed toward, or lacking positive knowledge about, a definite event". Chugh and Bazerman examine the aspects of bounded awareness. They define bounded awareness as individual's "failure to see and use accessible and perceivable information, while seeing and using other accessible and perceivable information" [4] and "a phenomenon that encompasses a variety of psychological processes, all of which lead to the same error: a failure to see, seek, use, or share important and relevant information that is easily seen, sought, used, or shared" [5]. This approach to unawareness sets a broad framework, allowing a wide range of possibilities for individual differences. This can be related to previous extensive research regarding perception flaws, cognitive illusions and heuristics, and bounded rationality [17–20]. The awareness and assessment of a game's existence can vary over individual assessments given perceptions, common knowledge, memory retention, information interpretation, and the ability to conduct outcome calculation.

Blasch et al. [6] provide an extensive review of situation awareness in game theory, while defining a game situation as "economic effort to extract either a real or virtual monetary payoff". As a systematization of their review, they offer an explanatory figure. They distinguish awareness and assessment, which can be related to the Perceptual cycle model of situation awareness. Awareness consists of entity awareness, situation awareness, cyber awareness, and knowledge awareness. The assessment is consisted of object assessment, situation assessment, network assessment, and social assessment. Application of this approach to basic game theory elements would refer to awareness and assessment of the other player(s), interaction (action), and the outcome. Additional elements that an individual may be aware of and assess are the rules and game context, as well as possible and feasible strategies. However, Halpern and Piermont [21]'s approach to (un)awareness does not have a distinction between the awareness and the assessment. The authors propose partial awareness, where the player: values different objects (or different states of the objects) the same, if their properties are the same; can value objects differently if they can be distinguished in some way that individual is aware of; can base their own preferences only on the properties that they are aware of. Such an approach implicates that an individual must be able to assess (evaluate) some properties to be aware of them. The difference in approaches indicates that the relationship of the awareness and assessment requires further investigation. Whether the awareness precedes the assessment, or the assessment is a part of the awareness, those constructs are interlinked and often used interchangeably.

Von Thadden and Zhao [22] find that unawareness requires modeling restricted decision making by agents. Chen et al. [16] argue that plausibility says that "player's unawareness arises if the agent does not know that the event is true, and that the player does not know that he or she does not know it". Authors offer a concept of player's introspections, which allows the player not to know about their own unawareness or to be unaware of their own unawareness. Heifetz, Meier, and Schipper [23] examine dynamic interactions where the player has unawareness of their available actions. Action availability is relevant because of its strategic implications: unawareness of the action is distinct from the unavailability of the action. They suggest that players can become aware of new aspects of the dynamic interaction through the game, where the player's evolving belief must be represented by a belief system as a part of the definition of the game (and cannot be defined as an initial probabilistic belief about nature). This provokes a thought about a possible extension—can the same findings be applied to the distinction between the availability, existence, and awareness of the action(s) of other players? Ozbay [24] finds that players can extend their awareness if they come to a node in the game that they were not aware of before. The author discusses the problem of assigning zero probabilities to actions/outcomes, which can be applied if a player receives information through the in-game communication that can be perceived as cheap talk.

Much of the previous research considers uncertainty and beliefs about game elements, such as: other players' preferences, information, available actions, and possible outcomes [9,25–27]. The findings from the epistemic logic approach provide context and relevant influencing factors for the theoretical consideration of awareness. Halpern and Rego [11] use primitive prepositions to generate awareness. They find that knowledge represents a relevant part of modeling unawareness, and distinct implicit knowledge ("truth in all worlds the agent considers possible") and explicit knowledge ("conjunction of implicit knowledge and awareness"). They find that there exists a subjective view of the objective situation and that view can result from the limited agent's vocabulary. Same authors [13] examine a general solution concept where some possible game histories are removed, while others may be augmented. In such a game representation, a player may reach a certain node in the game and not be aware that he is experiencing a subjective representation of the game, which may include a "virtual" move for another player. That implies that players' payoff beliefs include moves that have no relationship to the underlying game or actual payoffs. Halpern and Rego [1] examined the lack of common knowledge in games. These authors' approach allowed "the augmented games to be based on different underlying games", where players reveal the underlying game through a game, while also revealing a lack of common knowledge.

Rabin [28] forms a model of pre-game communication and examines its impact on the game equilibrium. Neuberg [29] examines how the influence of information perceived outside of conscious awareness influences social behavior. This author observes that the strategies players use differ given the subliminal information that they were exposed to. Even though the experiment was conducted during the game, and not prior to it, it reveals the intuition of individuals grasping signals about strategic interaction from their surroundings. According to Camerer [17], the most useful research regarding a behavioral 'pre-game' theory are unstructured games derived by Neale and Bazerman, a series of negotiation experiments, designed to resemble realistic negotiation situations (and not a game). Afterwards, the results of such experiments can be used to verify whether results confirm game theory presumptions and axioms. This served as an inspiration for the scenario approach, which will be used in this paper.

The existing research mostly focuses on (un)awareness definitions, resulting strategies, and outcomes prediction in an ongoing game, rather than assessing the perception and the belief about the game's and game elements' existence. It is important to notice the distinction: once the individual is aware that he or she is part of a game, it is likely that he or she will focus his or her efforts on recognizing and perceiving game elements; meanwhile, awareness of a game existence represents an individual's ability to detect whether game elements and a game exist in the first place. Moreover,

the unawareness of the game elements and game existence leads to an individual's failure to act and to strategically influence the interaction outcomes.

The research in the fields of security and gaming raised the question of empirical assessment of situational awareness [7,8,30–32]. This empirical research of (un)awareness represents a motivation for an empirical approach to determine an individual's awareness of game elements and game existence in everyday game-like situations.

2.2. Assessing Game Presumptions on a Personal Level, Under Incomplete Information And Uncertainty

If an individual wants to figure out whether a game exists, he or she might stumble upon an ambiguous situation. The beginning of the analysis requires a descriptive approach. If the individual can identify game elements, then he is probably in a game. However, a distinction must be made regarding the intentions of any other player: actions can have deliberate or unintended effects an individual's payoffs. Consequently, the game's existence might not be determined if an individual believes that the other player's action is not related to him, and if presumed effects on his payoffs are unintended.

Assuming that individuals differ given common knowledge (or lack thereof), perception flaws, information interpretation, and their ability to calculate probabilities and outcomes, their detection and identification of game elements (GEE) and a game's existence (GE) will vary.

To figure out whether there is a game, the individual should start by answering the following set of questions:

- Are someone's actions and strategies influencing my possible outcomes?
- Who are the players who choose those actions and strategies?
- Which actions and strategies have already been played?
- What are the possible outcomes and how do other players' actions influence the set of possible outcomes?
- What are the other players' preferences given the actions and strategies employed?

Also, it is necessary to make a distinction about game element detection (awareness about the GEE) and game element identification/description (assessment of the GEE).

Usually, the individual cannot answer these questions with certainty due to their lack of complete information, but they can assign a certainty or belief (probability) to each answer, respectively:

- certainty or belief assigned to awareness that someone's actions influence individual's possible outcomes β_A
- certainty or belief assigned to awareness that players exist β_B
- certainty or belief assigned to assessment that actions and strategies exist that have already been employed β_C
- certainty or belief assigned to assessment of players β_D
- certainty or belief assigned to assessment of possible outcomes β_E
- certainty or belief assigned to the assessment of their own possible payoff β_F

The probabilities denote the level of certainty, confidence, or belief that the provided answer to a question about GEE detection/description is true. Questions differentiate awareness and assessment according to Blasch et al. [6]. Those efforts, which an individual should make before modeling a game are systematized in Table 1.

Table 1. Game elements detection and identification with associated beliefs.

Element	Individual's Answer	Belief
Action detection	Yes/No/Not sure	β_A
Player detection	Yes/No/Not sure	β_B
Action identification	Description	β_C
Player identification	Description	β_D
Defining set of possible outcomes	Yes/No/Not sure, description	β_E
Defining own possible payoff	Yes/No/Not sure, description	β_F
Game existence belief	/	β

Source: Author.

Every further assessment requires time and information search and as such, exceeds the scope of this research.

The answers about game elements can be coded (for example as a binomial variable, where occurrence of detection or description is coded as 1, else 0). Additional quantitative information is derived from the assigned beliefs.

There is some other information relevant for belief asignment. The set of reasoning, computation, information interpretation and memory retrieval of the common knowledge could, but does not have to be done at the conscious level, as Salehnejad [33] finds that learning through continuous belief updates makes the homo economicus an intuitive Bayesian statistician—where some of the reasoning does not occur at the conscious level.

3. Examining Game Existence Awareness Using a Scenario Technique

3.1. Scenario Technique and the Data

To assess an individual's ability to recognize a game-like situation, exploratory research is conducted to gain initial insights. The survey was conducted in 2020 on a convenient sample of 87 first year students of economics and business economics[1]. After removing the incomplete answers and answers whose respondents had game theory knowledge, 48 responses per scenario were used in analysis, with total of 432 observations. The average age of the respondents is 19.48 with standard deviation of 0.13. Each respondent answered questions about nine scenarios. The examination was conducted without any instructions that would involve game theory elements.

The first seven scenarios are unstructured (or semi-structured) game-like situations describing several everyday situations, while the last two present structured game-like situations (an adapted prisoner dilemma and adapted extended-dictator-trust game). The first seven scenarios are vague on their purposes, as everyday situations usually do not occur as structured games with the predefined rules, but require individuals' awareness and assessment under circumstances of incomplete information and uncertainty, followed by an the information search and in-game assessment (the latter two extend the scope of this paper). Only the last two scenarios state possible actions for the respondents. The overview of the scenarios and provided information is presented in Table 2.

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[1]　No incentive in the terms of material reward was provided, but the students could choose this task instead of the regular practice assignment (and would receive points; if they provided thoughtless answers, they would receive no points).

Table 2. Scenarios and provided information.

Scenario 1	You are going to the shop to do your usual grocery shopping. Besides the items on your usual shopping list, you intend to buy your favorite chocolate. When you arrive to the shelf with the chocolates, you learn that your favorite chocolate's price increased by 10 HRK (approx. $1.57).
Information regarding action	The price increase
Information regarding player(s)	Not stated explicitly (it can be recognized as a shop/shop manager, manufacturer, distributor, etc.)
Information regarding payoff	Loss of 10 HRK in the case of a purchase/lack of chocolate in case of a non-purchase
Scenario 2	You are at a usual cafe hanging out with a friend. You notice that your friend is behaving slightly different and is somewhat restrained. Moreover, you notice an unusual look that can be interpreted as playful or mischievous. You are trying to figure out what that would mean: maybe it is a secret about preparations for your upcoming birthday, maybe the friend knows something you do not know (e.g., some gossip or some footage that has appeared on YouTube), maybe the friend is about to announce something important, maybe he or she is conducting a scheme, maybe … There may be a lot of options and maybe they have nothing to do with you.
Information regarding action	Non-verbal signals
Information regarding player(s)	Not stated explicitly (a friend with whom an individual is drinking coffee, or a third party)
Information regarding payoff	Not stated explicitly (the payoff could be both positive and negative)
Scenario 3	You arrive to work. You expect the usual tense working pace, and in addition to all your existing obligations, you get another one. Lately you have caught a few glances and greetings from other colleagues, and the reasons for these changes are not quite clear to you. You figure that you may be promoted to a better position. During the break, you meet a colleague and you mention the amount of work you need to do. With understanding and good intent, your colleague admits to you that one of your colleagues spoke badly about you. Moreover, it was the person who assigns you your tasks.
Information regarding action	Two separate actions are stated: workload and a rumor
Information regarding player(s)	Two players are stated: colleague and task assignor
Information regarding payoff	Not stated explicitly, but both positive and negative payoffs indicated
Scenario 4	A month ago, you started a seasonal job. This season is better than the last one for the company's turnover. There is a rumor amongst your colleagues that all the employees could get a raise.
Information regarding action	A rumor
Information regarding player(s)	Not stated explicitly (the rumor's source is the colleagues, but the payer is the company)
Information regarding payoff	Not stated explicitly (a raise is stated as a possible payoff, but without the information about the amount)

Table 2. *Cont.*

Scenario 5	You have received a team assignment to conduct some research and to report the results in a written form. There are four of you in the team. Your part of the assignment is to create a questionnaire. You are unfamiliar with designing questionnaires, so you contact one of the team members to help you. At that time, you learn that one of the team members already assembled the questionnaire.
Information regarding action	Activities within a team assignment
Information regarding player(s)	Team members
Information regarding payoff	A grade
Scenario 6	You are a manager of a department for consulting clients in a leading consulting company. The company is well known for its large number of clients and for the lowest prices of its services. You meet a client and, in an informal conversation at the beginning of the meeting, he/she reveals that he/she has been contacted by a newly opened consultant company that offered their services at a lower price.
Information regarding action	New competitor that offers a service at a lower price and/or a client's attempt to negotiate lower price
Information regarding player(s)	Newly opened consultant company and/or a client
Information regarding payoff	Not stated explicitly, but indicates loss (implicitly, it can be the loss of market share to competitor and/or a diminished price charged to a client)
Scenario 7	You have come up with an idea to start your own business. Even though all the people who hear about the idea agree that it is an excellent idea, you do not have the capital to start the company. You consider giving up the idea, given that you cannot finance it. At that time, you receive an invitation to pitch your idea in front of five investors. If you impress the investors, they could decide to invest.
Information regarding action	Invitation to pitch the idea
Information regarding player(s)	Five investors
Information regarding payoff	Not stated explicitly (the possibility of investment—positive payoff—of an unknown amount is indicated)
Scenario 8	Your colleague and you have been accused for cheating in an exam using unallowed electronic devices and are taken in front of the faculty's ethical committee for interrogation. You and your colleague are placed in separate rooms and cannot know what the other one is saying during interrogation. The ethical committee member who conducts the interrogation makes the following offer to each of you: "You may choose to confess or remain silent. If you confess and your accomplice remains silent, you will not be punished, and your testimony will be used to ensure that your accomplice gets a year of suspension. Likewise, if your accomplice confesses while you remain silent, s(he) will go free while you get a year of the suspension. If you both confess there will be two punishments, but I'll see to it that you both get only 6 months of the suspension. If you both remain silent, I'll have to settle for a token punishment for having unallowed devices during the exam and you will get 1 month of suspension."

Table 2. *Cont.*

Information regarding action	Confess or remain silent, for both players
Information regarding player(s)	A colleague
Information regarding payoff	0, 1, 6, or 12 months of suspension
Scenario 9	You and your colleague participated in a presentation for your faculty. At lunch, you were given the last sandwich, so your colleague is left with none. Your colleague promises to take you for a coffee later, hoping that you will give him a piece of your sandwich now. You can decide to trust your colleague and give him a piece of the sandwich or keep it all for yourself.
Information regarding action	A promise of the colleague and own action about sandwich allocation
Information regarding player(s)	A colleague
Information regarding payoff	A possibility of a coffee, and a piece of/whole sandwich

Source: Author.

During the question framing, special attention has been devoted to the word choice. The outcome and action are specific game theory terms which are not commonly used in everyday communication and a respondent without prior game theory knowledge might have a problem with understanding the question. The term action is replaced with the term activity (which is similar, but more commonly used). The term outcome is replaced with the term welfare in the first question, but is introduced in later questions.

Based on the scenario, students had to answer the following questions:

- is it possible to detect any activity that influences your welfare (economic or otherwise)? Please provide your determined certainty[2] as the answer (0–100%),
- can you detect and identify that activity? Please provide your determined certainty as the answer (0–100%),
- can you determine/detect a person (or group/association/company, etc.) who initiated the activity? Please provide your determined certainty as the answer (0–100%),
- can you identify a person (or group/association/company, etc.) that initiated the relevant activity? Please provide your determined certainty as the answer (0–100%),
- can you determine desirable outcomes for that person (or group/association/company, etc.)? Please provide your determined certainty as the answer (0–100%),
- determine the outcomes for yourself regarding the initiated activity (positive/ negative/ do not know)? Please provide your determined certainty as the answer (0–100%),
- do you believe that something is going on that affects you and that there exists a person (or group/association/company, etc.) whose activities influence your outcomes? Please provide your determined certainty as the answer (0–100%),
- do you believe that activity was deliberate or accidental? Please provide your determined certainty as the answer (0–100%).

For example, in the first scenario, a respondent can detect that there exists a player who has employed an action with 90% certainty in his response, and can assess that the player is a manufacturer with 70% certainty in his response. The detection is used as an indicator of awareness and a description is used as an indicator of assessment.

It is expected that:

- the respondents' detection (awareness) and description (assessment), as well as assigned beliefs, will differ over the scenarios;
- the respondents' detection (awareness) and description (assessment), as well as assigned beliefs, will differ given the provided information amount and action types.

Additionally, the analysis will examine:

- whether the "players" understand the game the same way as the modeler does;
- patterns and inconsistencies in game and game elements awareness and assessment;
- the relationship between awareness and assessment.

3.2. Data Insights

The gathered data was coded to enable quantitative analysis. Qualitative yes/no answers regarding detection (awareness of GEE) are coded as 1 and 0, respectively. Answers regarding the description of action, players, and outcome (assessment of GEE) are coded as 1 if a description is provided, while the lack of any description is coded as 0. To respect the respondents' subjective perception, the description

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[2] The term certainty is used in psychological and not epistemic interpretation. A level of certainty in provided answer is respondent's belief that his or her assessment is true/correct.

answers are accepted as identification if they relate to a possible interpretation of the scenario and are consistent (for example, in scenario 4, a respondent can identify a rumor or a raise as an action and the company/boss or colleagues as the players). There are no correct or wrong answers, because descriptions of most scenarios allow different interpretations. It can be argued that there are correct and wrong answers, at least for Scenarios 8 and 9. However, the respondents may interpret even the structured scenarios in their own, unexpected way. The modeler's standpoint could present an independent or even rational reference for response evaluations, but such an approach would seem more like an attempt to fit the empirical data into the existing game theory/bounded rationality framework (normative approach), rather than to gain insights from the empirical data (descriptive approach), and preferably use them to confirm or to improve the modeling. The later approach is used in this paper and it is allowed to the respondents to subjectively perceive and interpret their situation. Such an approach provides insights into individuals' awareness and assessment of the situation, which is in line with the research goal. To clarify, the goal of this paper is not the assessment of the deviations from the rational or expected responses, but to explore and to quantify the way that individuals assess situations involving (the possibility for) strategic interactions, namely their awareness and assessment of the game elements and game existence in such situations.

The resulting relative frequencies (percentages) from the coded answers are presented in Table 3.

Table 3. Relative frequencies (%) of answers about detection and identification.

Scenario	Whether Detection or Identification Occured or Not	Action Detection a_A	Action Identification a_B	Player Detection a_C	Player Identification a_D	Possible Outcomes Identification a_E	Expected Payoff a_F	Game Existence a_{GE}
1	Yes	83.33	79.17	83.33	79.17	77.08	93.75	87.50
	No	16.67	20.83	16.67	20.83	22.92	6.25	12.50
2	Yes	93.75	77.08	81.25	64.58	41.67	87.50	87.50
	No	6.25	22.92	18.75	35.42	58.33	12.50	12.50
3	Yes	95.83	79.17	91.67	85.42	60.42	91.67	87.50
	No	4.17	20.83	8.33	14.58	39.58	8.33	12.50
4	Yes	81.25	68.75	79.17	72.92	72.92	97.92	83.33
	No	18.75	31.25	20.83	27.08	27.08	2.08	16.67
5	Yes	93.75	81.25	89.58	77.08	58.33	97.92	83.33
	No	6.25	18.75	10.42	22.92	41.67	2.08	16.67
6	Yes	89.58	81.25	83.33	70.83	77.08	93.75	83.33
	No	10.42	18.75	16.67	29.17	22.92	6.25	16.67
7	Yes	100.00	83.33	91.67	68.75	95.83	95.83	87.50
	No	0.00	16.67	8.33	31.25	4.17	4.17	12.50
8	Yes	83.33	81.25	77.08	75.00	72.92	95.83	89.58
	No	16.67	18.75	22.92	25.00	27.08	4.17	10.42
9	Yes	91.67	83.33	87.50	79.17	89.58	85.42	81.25
	No	8.33	16.67	12.50	20.83	10.42	14.58	18.75

Source: Author's computation.

The relative frequencies of detection and identification responses show that detection and identification vary between the scenarios and over the game elements within the scenarios. Given this data, it could be concluded that respondents quite successfully grasp the information and strategic interaction presented in the scenarios. It can also be noticed that no learning curve occurred over the scenarios. It is interesting that the detection and identification values do not appear to reflect sensitivity to the information amount and type, showing only a slight variation in responses to vague and structured scenarios. Given the responses, it also seems that (some of) the respondents detect a game's existence, even without all game elements being detected/identified.

However, the Table 3 shows only the answers to detection and identification, without the assigned beliefs, so conclusions based only on this data might be misleading and further analysis is required.

First, a conjunction of coded answers to questions and assigned beliefs is calculated for each respondents' game element detection/identification:

$$\beta_{ir} = a_i \cdot \beta_{a_i r}, \ i = \{A, \dots F, GE\}, \ r = \{1, \dots, n\}$$

That is respondent's *r* belief regarding his/her detection/identification of the game/game element *i*. People assess and judge based on the available information and assigned probabilities. From the modeler's point of view, a game exists if all game elements exist. That means that the belief of the game's existence involves the intersection of beliefs on the game's elements. For simplicity, it is assumed that the respondents use the same underlying function. So, if respondents assess the game based on available information and assigned probabilities to the game elements as assumed by the modeler, then derived game existence beliefs are equal to

$$\beta_{GEE} = \prod_{i=1}^{6} |\beta_{ir}|$$

where i = {A, … , F}. In addition, if individuals assess their belief about GE and their beliefs about game elements using an intersection of beliefs, it is assumed that the assessments of GE belief should result in approximately the same value of the GEE belief. The deviations from the assumed equality of GE and derived GEE (because of the possible intuitive weighting of probabilities and psychological biases) are expected and considered in this research as $\beta_{GEE} - \beta_{GE}$ and will be examined to reveal whether patterns of deviations exist. The values reported in the Table 4 are averages of game, game elements, and derived game elements beliefs for each scenario.

$$\overline{\beta}_{si} = \frac{\sum_{r=1}^{n} \beta_{ir}}{n}, \ i = \{A, \dots, F, GE, GEE\}, \ r = \{1, \dots, n\}, \ s = \{1, \dots, 9\}$$

The results of the descriptive statistical analysis are presented in the table as average beliefs, calculated according to the previous description.

Along with the quantification of the responses, the descriptions of identification responses will provide complementary information.

The action of raising the price is clearly stated in Scenario 1, but the average belief assigned to answers about action detection is only 0.6896. It is interesting to notice that the average belief assigned to answers about player detection is higher than the belief assigned to answers about action detection, even though the other player has not been explicitly stated. For this scenario, another unexpected relation occurs: the action identification belief is higher than the action detection belief. Those seem to be paradoxical relations. Nevertheless, if they are observed in combination with reported values in Table 3, it can be noticed that the observation does not defy logic: it is not that more respondents become aware, but that respondents become more certain of the action existence's after its identification. This might be related to the abstraction level and characteristics of the objects and properties [21]. First, the action is more abstract than the player (in terms of construals), so becoming aware of it represents a

harder task for the respondents. That can explain the lower average action belief. Second, identification requires more effort and consideration than detection, which may explain the higher identification belief rate. When asked to detect something, respondents answer yes/no, and devote much less consideration to their answer. When asked to identify one, they have to describe it and write their answer, which forces them to consider their answer more thoroughly. Another possible explanation is that the individuals use the information outside of the given frame (such as similar previous experience) and ignore some of the provided information. The average belief assigned to action detection means that the students, on average, detected (are aware of) an action with 68.96% certainty/belief assigned to their answers. The assigned belief to player detection is 0.7375, which means that the students, on average, detected (are aware of) players with an assigned belief of 73.75%. The assigned belief to action identification is 0.6906 or in other words, the students, on average, provided a description of the action with a belief of 69.06% assigned to their assessments. The students, on average, provided a description of the player with belief of 64.06% assigned to their assessments. The assigned belief to negative payoff is 0.4056 (on average, students assessed that there is a negative payoff, and are on average 40.56% certain in their own responses). While most of the responses about own payoff identification offer a description of the loss of money and the loss of satisfaction from chocolate, 10.41% of the responses indicated a choice of not buying that chocolate until the price drops/switching to a substitute product/avoiding that shop in the future. Those responses indicate that some of the respondents not only perceive the situation as strategic, but also observe the situation as a sequential game where their choice can influence the action of the other player over time. Respondents described possible outcomes for other 'player' with an assigned belief in their responses of 64.02%. The GE belief is 0.3756, which means that the students are, on average, 37.56% certain that something is going on that affects their outcomes and that there exists a person (or group/association/company, etc.) whose activities influence their outcomes. The average derived GEE belief is 0.5521. Only 62.5% of the respondents stated that they perceive the price increase as being a deliberate action. The scenario indicates a relatively low loss, and the belief of expected payoff is negative, as expected, but low. That can be explained with the presumable choice not to buy the chocolate or to do that more rarely, hence cutting back the loss.

The students detected (are aware of) action in Scenario 2 with an average of 82.35% certainty/belief in their answers, the player is detected with an average assigned belief of 72.96%, action is assessed with an average assigned belief of 0.6563, the other 'player' is described with assigned belief of 0.551, the negative payment is estimated with an average assigned belief of 0.1367, the derived game existence belief is 0.3725, and the average game elements existence belief is 0.5052. The second scenario is vague (especially compared to the first one), so the average action detection belief is higher than expected. That might indicate an individual's inclination to perceive and interpret nonverbal communication as the action itself (moreover, most of the respondents who recognized the action/signal stated that non-verbal behavior is an indication that something is going on; from descriptive answers before coding). The other player is not clearly stated (it can be a friend, but also a third party) and the average player's detection belief is lower, as is the game existence belief. This could be interpreted using additional information as showing that 62.5% of the respondents found this action to be deliberate. That might mean that the individuals observed and acknowledged the activity, but also used their experience from similar situations and previous experiences. Almost all respondents who provided a player description indicated a person present at the hangout as the other player. Additionally, 43.75% of the respondents assessed their own possible outcomes as being positive and 10.41% of the respondents stated that they assume it will be a positive surprise (for example, for a birthday). Almost half of the respondents who expected a negative outcome showed stressed or hurt emotions while describing their own outcomes (27% of the respondents). The inclusion of the emotions in their own payoff indicates that the respondents in this case used emotions as a currency to demonstrate their loss. While this is an interesting observation, it extends the scope of this paper. In addition, there were two responses which offered a description related to a similar situation which they had previously encountered.

Table 4. Descriptive statistics of the beliefs.

	Action Detection β_A	Action Identification β_B	Player Detection β_C	Player Identification β_D	Possible Outcomes Identification β_E	Expected Payoff β_F	Game Existence Belief β_{GE}	Derived Game Elements Existence Belief β_{GEE}	Difference $(\beta_{GEE} - \beta_{GE})$
					Scenario 1				
β_{1i}	0.6896	0.6906	0.7375	0.6406	0.6402	−0.4056	0.3756	0.2966	−0.0790
s_{1i}	0.0498	0.0553	0.0541	0.0530	0.0554	0.1161	0.0231	0.3499	0.3374
95% conf. level	0.1003	0.1113	0.1088	0.1066	0.1114	0.2336	0.0465	0.1016	0.0980
					Scenario 2				
β_{2i}	0.8235	0.6563	0.7296	0.5510	0.3585	−0.1367	0.3725	0.1678	−0.2047
s_{2i}	0.0386	0.0568	0.0546	0.0639	0.0642	0.1219	0.0234	0.3475	0.3342
95% conf. level	0.0777	0.1143	0.1098	0.1286	0.1292	0.2452	0.0470	0.1009	0.0971
					Scenario 3				
β_{3i}	0.8831	0.7133	0.8329	0.7513	0.5317	−0.5065	0.3869	0.2949	−0.0920
s_{3i}	0.0323	0.0564	0.0415	0.0505	0.0654	0.1013	0.0234	0.4107	0.3992
95% conf. level	0.0650	0.1134	0.0835	0.1016	0.1315	0.2038	0.0470	0.1192	0.1159
					Scenario 4				
β_{4i}	0.7273	0.5992	0.6842	0.6223	0.6365	0.7402	0.3690	0.2476	−0.1213
s_{4i}	0.0541	0.0615	0.0566	0.0593	0.0597	0.0695	0.0261	0.3729	0.3697
95% conf. level	0.1089	0.1238	0.1138	0.1193	0.1201	0.1397	0.0525	0.1083	0.1074
					Scenario 5				
β_{5i}	0.8781	0.7019	0.7860	0.7023	0.5260	−0.1102	0.3582	0.2140	−0.1442
s_{5i}	0.0374	0.0541	0.0479	0.0600	0.0669	0.1288	0.0265	0.3645	0.3524
95% conf. level	0.0753	0.1088	0.0963	0.1207	0.1347	0.2592	0.0533	0.1058	0.1023

Table 4. *Cont.*

	Action Detection β_A	Action Identification β_B	Player Detection β_C	Player Identification β_D	Possible Outcomes Identification β_E	Expected Payoff β_F	Game Existence Belief β_{GE}	Derived Game Elements Existence Belief β_{GEE}	Difference $(\beta_{GEE} - \beta_{GE})$
					Scenario 6				
β_{6i}	0.8263	0.7206	0.7473	0.6256	0.6925	−0.5848	0.3738	0.3350	−0.0388
s_{6i}	0.0452	0.0550	0.0539	0.0628	0.0587	0.0949	0.0264	0.4254	0.3753
95% conf. level	0.0909	0.1106	0.1085	0.1263	0.1180	0.1908	0.0532	0.1235	0.1090
					Scenario 7				
β_{7i}	0.9379	0.7758	0.8102	0.6288	0.8660	0.8502	0.3869	0.4319	0.0450
s_{7i}	0.0180	0.0537	0.0425	0.0645	0.0338	0.0554	0.0237	0.4415	0.4204
95% conf. level	0.0361	0.1081	0.0855	0.1298	0.0680	0.1114	0.0476	0.1282	0.1221
					Scenario 8				
β_{8i}	0.7519	0.6779	0.6860	0.6510	0.6446	−0.4023	0.3940	0.2758	−0.1182
s_{8i}	0.0547	0.0544	0.0599	0.0604	0.0610	0.1127	0.0225	0.3740	0.3367
95% conf. level	0.1101	0.1094	0.1206	0.1215	0.1227	0.2267	0.0453	0.1086	0.0978
					Scenario 9				
β_{9i}	0.8450	0.7356	0.7688	0.7058	0.8446	0.5190	0.3616	0.4670	0.1054
s_{9i}	0.0424	0.0528	0.0493	0.0575	0.0454	0.1063	0.0275	0.4363	0.4440
95% conf. level	0.0854	0.1062	0.0992	0.1156	0.0913	0.2138	0.0553	0.1267	0.1289

Source: Author's computation.

Scenario 3 represents a more serious interaction framework, which can explain why average beliefs are higher. The player(s) are hinted at, and the workload can be interpreted as a negative payoff. While some of the respondents focused on the workload as an action and the boss as the other player, others perceived the gossip itself as an action and all colleagues participating in the gossip as other players. In addition, 87.5% of the respondents assessed the action as being deliberate. The expected payoff is negative, as predicted. A total of 37.5% respondents viewed the superior or the boss as the other player, while 41.67% of the respondents stated that the colleagues are the other players, and 6.25% indicated both the superior and colleagues as players. The outcome identification reveals a series of outcomes that vary given the gravity and the time-frame: getting fired, thinking about quitting, the further increase of the workload, diminishing productivity and the work dissatisfaction, hurt feelings because of the rumors, stopping the rumors, working even harder, and earning a promotion. This scenario offers the widest variety of the outcome descriptions. There was one description that explicitly stated an inability to assess the situation because of the lack of previous experience and one respondent related the descriptions to their own situation at a previous or current job. However, the GE belief is quite low, which might be the result of presumed future uncertainty.

The only solid information in Scenario 4 is that the company's turnover has increased, while the information about the raise is stated as a rumor. The overall average beliefs are moderate (in comparison to other scenarios), and 60.42% of the respondents assessed the action/signal as being deliberate. There were 20.83% of respondents that identified a raise as the action, 16.67% of the respondents stated that the action is the increase in company's turnover, while the rest of the respondents who provided the action identification saw the activity to be a rumor about a raise among the colleagues. By the time the respondents answered about their own outcome identification (expected payoff), it seems that some of the respondents started to 'believe' the rumor, as 62.5% stated an increase in the salary as the payoff (some of them even offered a plan on how to spend the raise). Also, 12.5% of the respondents stated that their motivation would rise, as well as the effort put in the work, and suggested that this should lead to the expected raise. The remaining respondents who offered a description remained cautious and used terms such as 'expecting' or 'hoping', usually in combination with positive emotions related to that expectation or consideration of trust issues regarding the rumor.

Scenario 5 indicates a multi-player situation with an assignment division, while the payoff is a grade. A total of 58.33% of the respondents found the activity to be deliberate. Given the provided information, the average GE belief is rather low (the lowest in comparison to other scenarios). The belief of the expected payoff is negative, as expected, but also low. While most of the respondents assessed the action and the player(s) as expected, the responses differed given the payoff identification. A total of 43.75% of the respondents expected the outcome to be positive, as they do not have to do the job. However, the rest of the respondents assessed their outcome as being negative and offered descriptions that indicate that they expect to do another, heavier part of the workload. They also expressed worry because they could get a lower grade, or were hurt and felt left out.

Scenario 6 can describe a market competition situation, with a statement from the other players and an indication of their strategy, or can be interpreted as a cheap-talk game with a client. A total of 62.5% of the respondents saw the other company as a player, while only 8.33% viewed the client as a player. A total of 75% of the respondents believed that the action described in the scenario is deliberate. While a negative payoff was expected, the average GE belief is quite low, which in combination with the descriptive answers indicates that the respondents did not fully recognize the threat of the competition or perceived the situation as bluffing by the client.

Scenario 7 describes a situation of a person who has a business idea and was offered a chance to pitch the idea in front of the investors. The provided action/signal was interpreted as deliberate by 81.25% of the respondents. While the invitation (to pitch the idea with the possibility of investment), observed as an action is only a signal without a real payoff, the average belief assigned to action detection assessment was the highest in comparison to other scenarios. The expected payoff belief was also unexpectedly high, suggesting respondents' (over)confidence and optimism towards winning

over the investors. The descriptive responses support that statement, but also indicate that some of the respondents treat the game as sequential, focusing on the payoff that will result from their (excellent) presentation. One descriptive answer stated the inability of the assessment, because of the lack of any previous experience.

Scenario 8 is an adaptation of the prisoner's dilemma and represents a structured game theory example. Only 62.5% of the respondents found the activity to be deliberate (the same percentage as in the first and second scenario). It is surprising that respondents, on average, detected activity with a 0.7519 assigned belief rate, and identified the activity with a 0.6779 assigned belief rate. The average player detection and identification beliefs are low, given that all included parties are clearly stated in the scenario. In addition, 20.83% of the respondents who provided an answer for player identification (75%, Table 3), identified the person who conducts the interrogation as the other player, suggesting that they perceived the situation as a cheap talk game with the interrogator. A total of 6.25% of the respondents offered a long-term outcome identification that extends the game framework (would never cheat again/it is bad for society that cheaters finish college). Nevertheless, the most unexpected outcome was the low GE belief value, given that it is a scenario with complete information. This suggest that some individuals fail to assess the situation as strategic and include additional information or disregard provided information.

Scenario 9 is an adaptation of the extended dictator trust game. Table 4 shows that this scenario has the second lowest GE belief, and that the other awareness and assessment beliefs are lower than expected. Some of the responses regarding individuals' own payoff indicate that some of the respondents recognized the trust issue (14.58%), other respondents stated that they cannot identify their outcome (14.58%), while some respondents referred to an altruistic approach and a positive payoff from the satisfaction of doing a good deed (8.33%). Given the responses of the majority of the respondents (that can be classified as trust issue, tradeoff, or not-sharing) it seems that the homo economicus is still very much alive. On the other hand, all the respondents whose answers could be classified as focusing on the trust issue and a tradeoff stated that they would give/trade 'half' of the sandwich (although the scenario states "a piece"), presuming a fair trade. In addition, there were only 2.08% of the respondents that perceived the game as sequential, stating that they would first wait for the fulfillment of the colleague's promise before sharing.

Given these insights, there is a clear indication that some of the respondents did not understand the game in the same way as the modeler does [1]. The best example of this is Scenario 8, which qualifies as a structured game with all information provided. It was unexpected that almost a fifth of the respondents perceived the game as involving bluffing. It seems that the respondents systematically show deviation from the provided information (whether by including information from their previous experience or disregarding the provided information), which is also in line with the critique of the standard game representation [1]. Also, the respondents occasionally extended the given framework and offered solutions that turned an assumed one-stage game into a sequential one. That indicates a different respondents' perception of the framework based on the time. The implications of such behavior can relate to inclusion of the 'virtual' moves and players' payoff beliefs that include moves that have no relation to the actual game and payoff [13]. The additional argument for this given observation is the average difference between the derived GEE belief and GE belief. While those differences show the deviation from the presumed underlying assessment process, they may also indicate the presence of psychological biases [4,5], intuitive probabilities weighting [33], or the use of different assessment functions.

It can be noticed that the average detection and assessment beliefs are lower than expected, especially for Scenarios 1, 8, and 9, with an exception for Scenario 7. The insights from the identification answers reveal that many of the respondents recognize the game elements and decision-making situation, but only some of the answers indicate consideration of strategic behavior and their own role in the outcome. That could explain the low average GE belief. However, the individuals' own outcomes (payoff) identification answers reveal that most respondents intuitively include their own

choice or possible actions while assessing their payoff. Given that the Scenarios 1, 3, 4, 6, 7, and 9 present a simple, everyday situation with economic significance, the lack of awareness about the GE also suggests that in most of simple real-life game-like economic situations, some individuals will not practice strategic behavior, and will only make decisions regarding the immediate choice (disregarding strategic implications) or passively accept the changes.

Although the average beliefs of GE over scenarios are small, they do exist and indicate that, on average, the individuals are at least partially aware of strategic interactions, which opens the possibility for future empirical examination of augmented games, as presented by Halpern and Rego [1].

The comparison of the average deviation of GE belief from the derived GEE belief ($\beta_{GEE} - \beta_{GE}$) shows small deviations over the scenarios. It is expected for the GE estimation to be close to the derived estimation of the GEE. The deviations point to underlying patterns in forming the GE belief that take in account the beliefs assigned to GEE detection and identification. However, some of those deviations are positive, while others are negative (Scenarios 1, 2, 3, 4, 5, 6, and 8), indicating an overestimation or underestimation of the GE belief, given the respondents' own awareness and assessment of GEE. Also, it seems that there is a relationship between the expected payoff and the difference (Table 4).

As some of the previous research suggests, the awareness precedes assessment. The identification could intensify the awareness, which is in line with the Halpern and Piermont model [21]. The awareness in terms of "something is going on", without the assessment, might be significant for the alertness, but could only have implications for strategic behavior when combined with the assessment. However, the empirical data (aside from Scenario 1) does not suggest the same conclusion about that relationship.

Provided data insights reveal the inconsistencies in the awareness and assessments over the scenarios, indicating that variations of the information amount and type may influence provided answers, and as such, require further investigation. The following section will examine the differences in responses regarding the scenarios, provided information level, payoff type, action type, and the perceived deliberation.

3.3. Game Elements and Game Existence Beliefs

To confirm the first insights, it is necessary to provide statistical analysis of differences in responses regarding the provided information in scenarios, payoff (positive/negative), and type of action. Table 5 presents the results of a Kruskal Wallis test. The Kruskal Wallis test compares mean ranks between the groups and is appropriate for the analysis of the data with compromised normality. The Monte Carlo method is applied because of the relatively small number of observations and to enable an unbiased estimate of the exact significance level. The tested hypotheses are that there are no statistically significant differences in mean rank of responses about game elements given the scenario, information, payoff, type of action, and deliberation.

Scenarios differ given the provided information and context. Given the individual responses, there are differences in responses within a scenario, which are revealed in standard deviations (Table 4). However, the variations between the scenarios should indicate respondents' sensitivity to the context and the amount and the type of information provided. There are statistically significant differences in responses about action detection, possible outcomes identification, expected payoff, derived GEE belief, and the difference between GE belief and derived GEE belief, given the **Scenario** (Table 5). The revealed statistically significant differences affirm the variations of responses regarding the scenarios and confirm the grasp of the contextually different situations while forming the belief about the game elements. Nevertheless, the lack of statistically significant differences between the GE responses regarding the scenario reveals that the contextual approach does not reveal relevant factors for awareness and assessment of GE belief. It seems that some other factors, like the information amount, payoff, action type, and perceived deliberation may be the key for determining the differences in responses regarding the rest of the game elements and GE belief.

Table 5. Differences between game elements' existence estimates given the scenario, provided information, payoff, action type, and deliberation.

Grouping Variable	Parametar	Action Detection β_A	Action Identification β_B	Player Detection β_C	Player Identification β_D	Possible Outcomes Identification β_E	Expected Payoff β_F	Game Existence Belief β_{GE}	Derived Game Elements Existence Belief β_{GEE}	Difference/($\beta_{GEE} - \beta_{GE}$)
Scenario	Chi-Square	32.211	9.936	5.671	10.615	49.497	144.943	1.938	25.440	21.047
	df	8	8	8	8	8	8	8	8	8
	Asymp. Sig.	0.000 ***	0.270	0.684	0.224	0.000 ***	0.000***	0.983	0.001***	0.007***
	MC Sig.	0.000***	0.239	0.681	0.2	0.000***	0.000***	0.984	0.001***	0.002***
Information	Chi-Square	5.748	5.116	2.901	5.761	13.430	15.268	0.436	9.006	6.699
	df	2	2	2	2	2	2	2	2	2
	Asymp. Sig.	0.056	0.077	0.234	0.056	0.001***	0.000***	0.804	0.011**	0.035**
	MC Sig.	0.057	0.078	0.238	0.045**	0.000***	0.001***	0.818	0.012**	0.036**
Payoff	Chi-Square	4.195	2.253	9.778	0.183	3.457	334.761	6.528	0.685	2.199
	df	1	1	1	1	1	1	1	1	1
	Asymp. Sig.	0.041**	0.133	0.002***	0.668	0.063	0.000***	0.011**	0.408	0.138
	MC Sig.	0.041**	0.143	0.001***	0.676	0.065	0.000***	0.013**	0.425	0.121
Action type	Chi-Square	1.912	0.314	0.031	0.110	0.748	64.113	0.183	0.130	0.359
	df	2	2	2	2	2	2	2	2	2
	Asymp. Sig.	0.384	0.855	0.985	0.947	0.688	0.000***	0.912	0.937	0.836
	MC Sig.	0.417	0.85	0.987	0.953	0.698	0.000***	0.9	0.94	0.816
Deliberation	Chi-Square	11.203	1.111	10.573	9.672	26.796	1.390	14.138	12.710	3.149
	df	1	1	1	1	1	1	1	1	1
	Asymp. Sig.	0.001***	0.292	0.001***	0.002***	0.000***	0.238	0.000***	0.000***	0.076
	MC Sig.	0.001***	0.298	0.001***	0.004***	0.000***	0.234	0.000***	0.000***	0.069

Notes: statistical significance at 5% and 1% level are denoted ** and ***, respectively; M. C. stands for Monte Carlo; the Monte Carlo method is based on 1000 samples. The computation is conducted using SPSS (IBM, New York, NY, USA). Source: Authors' computation.

The average beliefs concerning the game elements are not consistent with the amount of provided information in the scenarios (Tables 2–4). Such an observation is partially unexpected, and it indicates that the other elements most likely influence the awareness of the game elements and game existence. This evidence can be explained by considering flaws of perception and reasoning that occur due to bounded awareness [4,5]. However, this indication requires more detailed insight into differences in game elements beliefs, given the information level provided. Scenarios differ given the provided information on the action, player(s), and payoff (Table 2). Given the provided information, scenarios are divided into three groups. The results (Table 5) show that there are statistically significant differences for player identification, expected payoff, possible outcome identification, derived GEE belief, and the difference ($\beta_{GEE} - \beta_{GE}$), given the amount of provided information (at a 5% level of statistical significance). This indicates that respondents, at least partially, manage to grasp the provided information. The statistically significant variables indicate the relevance of the information available for the identification, that is, the assessment.

An interesting observation can be made in regards to the perceived payoff belief (Table 4), which is negative for some of the scenarios. The outcomes identification beliefs are higher for the scenarios where the individual's own perceived payoff is positive. Also, GE beliefs are somewhat larger for the scenarios with a negative payoff. It is possible that respondents assign higher levels of certainty to their own responses regarding the positive outcomes but do the opposite faced with the risk of loss. That could indicate an estimation bias towards the positive/negative outcome, which can be related to Baumeister et al. [20]. In addition, the findings can be explained through a lens of unexpected utility: players "sometimes value losses differently than gains and can have aversions toward (or preferences for) strategic ambiguity or uncertainty" [17], which is related to the prospect theory [34]. Descriptive statistics and previous research indicate that positive or negative payoff/outcomes can bias the estimation of the GE. Given the responses about expected positive or negative payoff, scenarios are divided in two groups. The Kruskal Wallis test (Table 5) shows that there are statistically significant differences in action detection belief, player detection belief, expected payoff belief, and GE belief, given the perceived positive or negative payoff. The mean ranks show higher estimations of action detection belief and player detection belief for an expected negative payoff. The last statistically significant difference, GE belief, points to the payoff as a possible explanation for the differences in estimation of the GE, where higher estimation of GE belief occurs if the respondents expect negative payoff (which is in line with previous research). In addition, the perceived payoff seems relevant for the detection, that is, awareness.

Action type differs over scenarios and appears in the forms of the concrete action, signal and cheap talk, and non-verbal behavior. Given the type of action, three subgroups were created to test the differences. Table 5 shows that given the action type, there is a statistically significant difference only in the responses to the expected payoff belief. The lack of differences in the action detection and action identification beliefs given the action type is unexpected and it suggests that the respondents equally successfully interpret explicit action, signal, and non-verbal behavior.

The highest derived game existence belief is estimated for Scenario 8 (followed by Scenarios 3 and 7), and the lowest for Scenario 5. The value of the game existence belief for Scenario 5 is unexpected, given that information regarding all game elements is provided. Perhaps the reason for this is that 42.86% of the students found the action to be undeliberate or perceived that they would receive a team grade regardless of their own efforts in performing the assignment part. However, such a situation can also occur if the action is recognized as a type of deception [2]. Given this observation, it is necessary to examine whether the game existence estimations differ given the perceived deliberation of the interaction. The results show that there are statistically significant differences in action detection, player detection, player identification, possible outcomes identification, GE belief, and derived GEE belief, given the perceived deliberation. The deliberation seems to be the most significant assessment factor, as it reveals the differences in most of the observed variables (Table 5). It is interesting to notice that there is no statistically significant difference in expected payoff based on the deliberation. That can

lead to an assumption that the activity may be assessed as being deliberate or intentional, but that this will not be a cause of respondents' diminishing (or increasing) belief of their expected payoff.

The GE belief shows statistically significant differences only, given the deliberation and payoff. That indicates that the respondents' awareness of the game—the belief of the game's existence, does not depend on the context, provided information, or action type. However, as observed in combination with Tables 3 and 4, the results show that the respondents are at least partially aware and that the information amount does not imply complete awareness at the individual level. It is interesting to notice that the action detection does not show statistically significant differences regarding the information amount and action type, while action identification appears unaffected by any of the observed influences. Those insights indicate that respondents' beliefs include information that has no relation to the underlying game or actual payoffs [13].

The difference ($\beta_{GEE} - \beta_{GE}$), which points out to differences in estimation of the GE belief from the values estimated by the assumed underlying function, shows statistically significant differences regarding the scenario, information, payoff, and deliberation. The current observations and results indicate the relevance of the difference and its role in GE belief formation, but do not enable inconclusive conclusions. Hence, it is necessary to examine if there exist statistically significant differences in game elements beliefs and game existence belief, given the difference ($\beta_{GEE} - \beta_{GE}$). The data was divided into three groups regarding the positive, negative, or zero difference ($\beta_{GEE} - \beta_{GE}$). The Kruskal Wallis test with the Monte Carlo method was employed again.

The results show that there are statistically significant differences regarding observed game elements, apart from the expected payoff. It seems that a statistically significant difference of the game elements belief occurs that can be detected with the overestimation and underestimation of the GE belief in comparison with GEE belief, expressed in difference ($\beta_{GEE} - \beta_{GE}$). The mean ranks show that the respondents with a positive difference ($\beta_{GEE} - \beta_{GE}$) tend to overestimate game element beliefs (higher mean rank; except of the expected payoff belief) in comparison to the other two groups. The results indicate that both GE belief and GEE belief differ due to differences, with a lower mean rank scored for a negative difference and higher mean rank scored for a positive difference. That suggests that the difference does not only measure the deviation from the presumed underlying assessment process, but is related to most of the assessment factors, which indicates the presence of psychological biases [4,5] or intuitive weighting of the probabilities [33].

The GE belief differs given the payoff, deliberation (Table 5), and the difference (Table 6), where GE belief mean ranks are higher for the expected negative payoff, deliberate action, and positive difference. However, the provided analysis does not reveal the relation of all game elements belief to GE belief.

Table 6. Differences between game elements estimates given the difference ($\beta_{GEE} - \beta_{GE}$).

Grouping Variable	Parametar	Action Detection β_A	Action Identification β_B	Player Detection β_C	Player Identification β_D	Possible Outcomes Identification β_E	Expected Payoff β_F	Game Existence Belief β_{GE}	Derived Game Elements Existence Belief β_{GEE}
	Chi-Square	81.505	114.113	128.015	161.526	151.123	1.390	143.340	339.866
Difference ($\beta_{GEE} - \beta_{GE}$)	df	2	2	2	2	2	2	2	2
	Asymp. Sig.	0.000***	0.000***	0.000***	0.000***	0.000***	0.499	0.000***	0.000***
	MC Sig.	0.000***	0.000***	0.000***	0.000***	0.000***	0.519	0.000***	0.000***

Notes: statistical significance at 5% and 1% level are denoted ** and ***, respectively; M. C. stands for Monte Carlo; the Monte Carlo method is based on 1000 samples. The computation was conducted using SPSS. Source: Author's computation.

Thus, it remains necessary to examine the correlation between the game elements belief and the GE belief. It was suggested earlier in the article that it is expected that the GE estimation will be close to the derived estimation of the GEE, and that the small deviation points to underlying patterns in forming the GE belief that take in account the beliefs assigned to GEE detection and identification.

The correlation analysis points out the linear numerical relationship between observed elements and GE beliefs. Table 7 shows the result of the correlation analysis.

Table 7. Correlation analysis of the game elements existence beliefs and the game existence belief.

		Parameter		β_A	β_B	β_C	β_D	β_E	β_F	β_{GE}	β_{GEE}	$\beta_{GEE} - \beta_{GE}$
β_{GE}		Pearson Correlation		0.327**	0.270**	0.465**	0.350**	0.127**	−0.116*	1	0.306**	−0.125**
		Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.008	0.016		0.000	0.009
		N		432	432	432	432	432	432	432	432	432
	Bootstrap	Bias		−0.002	−0.001	0.000	0.001	0.000	0.000	0	−0.001	0.000
		Std. Error		0.057	0.052	0.050	0.051	0.051	0.048	0	0.041	0.047
		95% Confidence Interval	Lower	0.212	0.163	0.363	0.253	0.030	−0.214	1	0.222	−0.218
			Upper	0.437	0.370	0.566	0.445	0.230	−0.020	1	0.390	−0.030
β_{GEE}		Pearson Correlation		0.383**	0.505**	0.474**	0.580**	0.582**	0.013	0.306**	1	0.906**
		Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.784	0.000		0.000
		N		432	432	432	432	432	432	432	432	432
	Bootstrap	Bias		0.001	0.001	0.002	0.002	0.001	0.002	−0.001	0	0.000
		Std. Error		0.021	0.024	0.021	0.022	0.023	0.050	0.041	0	0.008
		95% Confidence Interval	Lower	0.343	0.458	0.437	0.540	0.536	−0.082	0.222	1	0.890
			Upper	0.422	0.555	0.516	0.625	0.628	0.110	0.390	1	0.922
$\beta_{GEE} - \beta_{GE}$		Pearson Correlation		0.254**	0.407**	0.287**	0.449**	0.550**	0.065	−0.125**	0.906**	1
		Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.177	0.009	0.000	
		N		432	432	432	432	432	432	432	432	432
	Bootstrap	Bias		0.002	0.002	0.002	0.001	0.001	0.002	0.000	0.000	0
		Std. Error		0.031	0.033	0.031	0.033	0.029	0.050	0.047	0.008	0
		95% Confidence Interval	Lower	0.191	0.340	0.228	0.391	0.491	−0.032	−0.218	0.890	1
			Upper	0.314	0.470	0.348	0.516	0.610	0.159	−0.030	0.922	1

Notes: statistical significance at 5% and 1% level are denoted * and **, respectively; Bootstrap results are based on 1000 stratified bootstrap samples (strata: scenario). The computation is conducted using SPSS. Source: Author's computation.

The correlation analysis reveals a statistically significant and positive, but weak to moderate linear correlation between all the game element beliefs and GE beliefs. Similarly, game elements (except for expected payoff) correlate with derived GEE and with the difference. While correlation exists and indicates that individuals use all game elements in game existence assessment, those correlations are moderate, indicating a possible weighting of the beliefs and/or underlying function that is not linear. Also, it is interesting to notice the negative relationship between the expected payoff and the GE belief. That means that a negative payoff leads to the higher estimation of GE belief, while positive payoff leads to lower estimation of GE belief. Although the relationship is weak, it is an additional indication that respondents estimate game existence differently based on different payoff, that is, they view situations differently given their expected losses or gains [17,20,34]. A similar relationship occurs for the difference. That weak negative correlation shows that for the negative differences, the GE belief is higher while the GE is lower for the positive differences. Besides that, there is a strong positive correlation between the derived GEE and the difference. Interpreting those two coefficients in combination, it might be that the difference is also an indication of internal correction processes, whether to account for uncertainty or to correct for overconfidence in game elements belief estimation.

4. Discussion and Conclusions

Game theory strives to model, explain, and predict human behavior in strategic interactions. A part of the research is devoted to individual behavior. While most models in game theory set a framework with the predefined rules and assuming that the players understand the game in the same way as the modeler, some research points out that such approach does not manage to grasp the reality of human behavior [1]. One of the gaps that occur relate to an individual's awareness of the game

and game elements. The research of (un)awareness in game theory aims to explain and to fill that gap. The theoretical framework is significantly developed, but the empirical studies on the topic are scarce. The importance of empirical insights lies in the results' implications, both for human interaction and game theory models. As game theory models aim to approximate human strategic behavior, the empirical data can confirm if the existing development of the (un)awareness in game theory heads to the right direction and provide valuable insights for theoretical modeling. An individual who is unaware of a game-like situation will fail to assess possibilities for strategic behavior, will not search for additional information, and will not reach the stage where awareness and assessment of the in-game elements play a role in the situation's outcome. Therefore, it is reasonable to suggest the awareness examination occurs prior to game modeling.

The purpose of this research is to examine individuals' awareness and assessment of game existence and to provide insights from the empirical data regarding the individuals' detection and description of game elements and assigned beliefs in contextually different situations. The emphasis of the analysis is based on the quantification of beliefs assigned to awareness and assessment of the game elements and game existence, as well as the patterns in their relationship.

Given that games in everyday life do not occur with predefined assumptions and rules, it is important to learn how successfully individuals manage to assess game existence and game elements. Insights into individual game existence assessment have strategic implications on game outcomes and suggest a new approach for applications of (un)awareness game theory models to real-life situations.

Do the respondents understand the game the same way the modeler does? The results provide empirical insights in respondents' game understanding, their deviating from provided information, breaking of the given framework, and deviating from the presumed underlying assessment function. This is revealed in the structured scenarios. All these findings support the critique of the standard game representation [1] and show that some of the respondents and the modeler do not understand the game in the same way. While this notion previously existed in theoretical approach, this research enables its empirical reinforcement. The implications of such behavior can relate to inclusion of the 'virtual' moves and players' payoff beliefs that include moves that have no relation to the actual game and payoff [13]. That suggest the necessity for future empirical examination of the awareness in the sequential games as well as individuals' ability to reveal the underlying game [1].

Do the respondents' awareness and assessment of game and game elements differ over the scenarios, and do they differ given provided information amount and type? The average awareness and assessment of game elements are inconsistent with provided information and in some cases, are lower than expected. As previously stated, the results indicate that individuals fail to utilize the provided information, but also use other information. The responses about action detection, possible outcomes identification, expected payoff, and game existence belief differed across the scenarios. The responses about player identification, expected payoff, and possible outcome identification belief differed given the information amount. The lack of statistical differences in most game elements (except for the payoff) given the action type suggests that respondents equally successfully interpret explicit action, signal, and non-verbal behavior. The insights from the identification answers reveal that many of them recognize the elements and decision-making situation, but only a part of those answers indicate consideration of strategic behavior and their own role in the outcome. The interpretation of those insights suggests that in most of simple real-life game-like economic situations, some individuals will not practice strategic behavior, and will only make decisions regarding the immediate choice (disregarding strategic implications) or passively accept the changes. In spite of the fact that GE beliefs were found to be smaller than expected, they do exist and indicate that, on average, the individuals are at least partially aware of the given information. The possible implications of the findings relate to modeling strategic interaction with incomplete information and uncertainty, as they highlight the role of information in game elements assessment. Also, the lack of any difference regarding the action type indicates that respondents do not assess explicit action as successfully as expected but do assess signal/non-verbal behavior more successfully than expected. That suggests that the

possibility of modeling the strategic interactions with observable explicit action as signal games should be further explored.

What are the insights about the relationship of the awareness and assessment? The argument for treating the assessment as a part of the awareness (as already assumed by Reference [21]) would be a useful insight for further theoretical modeling, but only the results of one of the scenarios supports such a conclusion. Given the inconclusive results regarding the relationship of the awareness and assessment, this topic requires future research. Besides the theoretical modeling, such an insight could have a practical implication. In the first scenario, the respondents appear to become 'more certain' in the action existence when asked for identification, which implicitly indicates greater awareness. If the individuals would ask themselves the same question in the real-life game-like situations, it can be assumed that their awareness would increase. If the awareness can be increased by asking questions about identification, that also suggests that it can be learned. Such a skill could prove to be valuable, especially for individuals in situations with high levels of uncertainty or a swiftly changing environment, whether it is a market situation, organizational environment, board of executives' interaction, or an interaction with colleagues.

Are there patterns in the game and game elements existence awareness and assessment? First, deliberation seems to be the most significant assessment factor, as it reveals the differences in most of the observed variables. That means that respondents assess game elements and game existence differently, given their assessment of deliberate or unintended activity. For example, a player might assess an uncooperative action as being unintentional and consequently would not assess it as a part of the game and/or would probably not apply, for example, a tit-for-tat strategy. The lack of statistically significant differences in expected payoff given the deliberation suggests that respondents treat the motivation/deliberation as being distinct from its consequences, such as the payoff. This could be integrated in modeling real-life situations in a game awareness theoretic framework.

Second, it is presumed from the modeler standpoint that all elements must be present for a game to exist, so the game existence detection should be equal to the smallest detection/identification game element percentage in the respondents' detection and identification answers. The deviations from that assumption suggests that respondents assume a game's existence even when not all game elements are detected/identified. The difference between the game existence belief and the derived game elements belief points out to overestimation and underestimation of the game existence belief and shows statistically significant differences regarding the scenario, information, and deliberation. That suggests a possible (quasi) hyperbolic underlying assessment function.

Third, the game existence belief shows statistically significant differences given the payoff and deliberation. The GE belief values are higher when deliberation and a negative payoff are present. The weak to moderate correlations between all the game elements beliefs and GE belief suggest that respondents at least partially use game elements while assessing the GE belief. However, the weak to moderate correlation suggests that it is possible that beside the observed elements, there are other elements and processes that play a role in GE formation, which points to the role of at least one form of psychological bias and information issues in the assessment process, which is in line with the previous research [4,5]. Individuals systematically differently estimate (overestimate and underestimate) the game's existence given the payoff. That suggests that payoff plays a role in the intuitive weighting of the probabilities. The role of payoff in that process relates to unexpected utility [17,20,34], where people value losses differently than the gain. In this situation, respondents assign different levels of certainty to a game's existence regarding the expected loss or gain. The theoretical modeling of game awareness should consider using different approaches, given the positive/negative payoff. The second bias refers to a failure to utilize the provided information, while possibly using the information outside of a situation frame (such as previous experience). That points out to the relevance of the memory stock and information retrieval examination in awareness models. The finding is in line with previous research [13] and opens a possibility for empirical examination of player's revealing the underlying game [1] in sequential/dynamic games.

Fourth, the revealed patterns also show that game awareness is not unpredictable, which can have practical implications. For example, in many pre-game situations, a player might prefer that the other player remains unaware of the possibility for a game for as long as possible. According to these findings, that is likely to happen if the first player primarily manages to conceal his deliberation and negative payoff from the second player. Such situations may occur in everyday life, whether it is a colleague's gossiping behind one's back, a company takeover, or a secretive change of the law without public discussion. The motivation for sustaining the lack of other's awareness is to achieve a preferable outcome by avoiding playing a game, which—depending on the situation—may have serious consequences for an unaware individual. That suggests that managing the other players' (un)awareness could be considered as a strategy in itself and requires further examination. On the other hand, the same situation should motivate individuals to detect a game-like situation, namely, to become aware and to play a game.

From this research, we learn that: some of the respondents do not understand a game in the same way as the modeler does; they are, on average, at least partially aware of a possibility for strategic interaction (even in vague situations); respondents approximately equally successfully interpret explicit action, signals, and non-verbal behavior; respondents' game awareness is related to the game elements; game elements are likely intuitively weighted in game existence estimation; the role of information (and common knowledge), psychological biases, and underlying GE belief assessment function require further investigation. This research brings us a step closer to understanding individual awareness of games in everyday life and represents the basis for further research that will, preferably, result in the application of individual awareness in real-life game theory models. The possible theoretical and practical applications involve micro-based behavioral economics, organizational and strategic management, market interactions, (un)awareness, and pre-game theory.

This research has several limitations. One of the limitations arises from the choice of the scenarios used in research. The choice of the employed scenarios, as well as the questions asked, can produce a framing effect. The framing effect is one of the psychological biases that might affect awareness, so additional examination is preferable. As there is no previous empirical research of the individuals' awareness of the game and game elements (known to the author), there is no baseline or consensus regarding the appropriate research approach and empirical results comparison is not possible. Although the scenario technique is an acceptable methodological choice for exploratory research, it is advisable to repeat the research in an experimental setting. However, the research design should be developed for future research to elicit a specific influence in relation to specific game element or game awareness. The empirical analysis is based on a small convenience sample, so the findings should be confirmed and generalized in more extensive research in the future. The limitations point to requirements for results validation, but some of the possible research directions also arise from the paper's findings.

While the paper tackles the topic of awareness at the individual level, it also reveals additional questions that require answers and remain as inspirations for future examination of: the influence of learning about awareness or game theory on the results of game awareness; the possibility of learning awareness; modeling game awareness given the presumption of deliberate/unintentional activity; the underlying function that describes game awareness estimation; psychological biases that influence game elements and game existence assessment; unawareness management as a possible strategy; and the role of information and common knowledge in game existence belief.

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