

The Semantics of Modal QAD in Standard Arabic

Abdel-Rahman Abu Helal *

Department of English language and literature, Al-Zaytoonah University of Jordan, Jordan

Received on: 15-2-2021

Accepted on: 6-10-2021

Abstract

The behavior of modal QAD in Standard Arabic presents a twofold puzzle: first, QAD has an inherent epistemic-denoting conversational background with its lexically-encoded quantificational force being controlled by the temporal-aspectual properties of QAD's prejacent. Second, universal QAD triggers an actuality entailment by default. We resolve this puzzle by proposing a compositional analysis of modal QAD that derives QAD's lexically-encoded duality of force and accounts for universal QAD's automatic implicativity.

Keywords: Epistemic-Denoting, Lexically-Encoded Quantificational Force, Actuality Entailment.

Introduction

The interpretation of modals draws on two types of information: an expression of necessities or possibilities and some description of content knowledge such as obligations, facts, laws, desires, evidence. As way of example, consider the following modal structures.

- (1) a. John must be the culprit.
(Epistemic necessity: in view of the available evidence)
- b. John may be the culprit.
(Epistemic possibility: in view of the available evidence)
- (2) a. John must print the assignment.
(Deontic necessity: in view of the course requirement)
- b. John may print the assignment.
(Deontic possibility: in view of the course requirement)

On a quantificational view on modality (Kratzer 1977, 1981, 1991, 2012),¹ the necessity-possibility distinction reflects the duality of the quantificational strength or force: necessity and possibility modals are universal and existential quantifiers over possible worlds, respectively. The necessity modal structure (i.e., $\Box p$) is true in some world w given that p is true in all relevant possible worlds accessible from w . The possibility modal structure (i.e., $\Diamond p$), on the other hand, is true in some world w given that p is true in some relevant possible worlds accessible from w .² Modals then are higher-order quantified structures which involve a triplet logical form that comprises a modal operator $\text{modal}_{\exists/\forall}$,

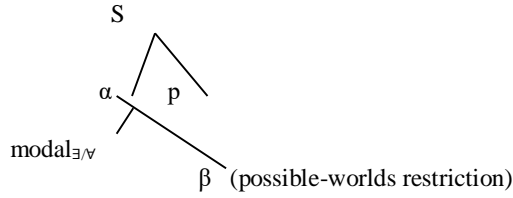
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* Doi: <https://doi.org/10.47012/jjml.15.1.3>

* Corresponding Author: abuhelal8318@gmail.com

a restriction β that denotes a set of possible worlds and its propositional scope p which also denotes a predicate of worlds as schematized in (3) (Krepke 1963, Schlenker 2006).

(3)



Kratzer (1977, 1981, and 1991) proposed that the set of worlds quantified over is determined by two contextual parameters. The first parameter is a conversational background f which is a function from worlds to propositions representing the modal base of the structure. These propositions describe consistent facts about the modal use which determines the flavor of modality (e.g., epistemic, deontic, circumstantial, etc...). For example, the modal structure (1) has an epistemic flavor which involves a modal base with propositions that correspond to the body of knowledge of the speaker which expresses pieces of evidence supporting John's involvement in the crime as represented in (4).

(4) $F_{\text{epis}}(w) = \{ p : p \text{ is a proposition that expresses an evidence piece known by the speaker in } w \}$

On the assumption that the set of propositions in (4) denote a set of sets of worlds, a generalized intersection yields the following set of worlds as in (5):

(5) $\bigcap F_{\text{epis}}(w) = \{ w : w \in W : \forall p \in f(w) \rightarrow [p(w)=1] \}$

The set of worlds in (5) can be expressed in terms of an accessibility relation R_{epis} (6):

(6) $w \text{ Acc}_{\text{epis}} w' = \{ w' : w' \text{ is a world in which all the propositions known by the speaker in } w \text{ hold true} \}$

The other parameter is an ordering source g which is a stereotypical function from worlds to propositions that represent the ideals or morals surrounding the modality use. The ordering source is used to order the set of worlds that is supplied by the conversational background f in such a way the modal ends up quantifying over the best ranked worlds in terms of a partial ordering \leq_g .³

To illustrate this precedence relation, for every w and w' and the set of propositions derived by g describing ideals, w is ranked at least as high as w' (i.e., $w \leq_g w'$) if and only if the set of g -propositions which are true in w is the superset of the set of g -propositions which are true in w' , as shown in (7).

(7) for all $w, w' \in W$ and for any $p \in g(w)$: $w \leq_g w'$ iff $\{ p \text{ s.t. } p \in g(w) \ \& \ w \in p \} \supseteq \{ p \text{ s.t. } p \in g(w') \ \& \ w' \in p \}$

Given ordering, the best ranked worlds which are the closest to the ideal is given by the function BEST which is a kind of choice function that takes as its argument sets of worlds and produce the best subset of the relevant set.

(8) $\text{BEST}_{\leq_g} (\bigcap F_{\text{epis}}(w)) =:$ a selection of the best ranked worlds from $(\bigcap F_{\text{epis}}(w))$ in light of the ordering relation \leq_g

To exemplify, the English modals in (1) and (2) enter the derivation with an intrinsic specification of modal force with the modal *must* being analyzed as universal and the modal *may* being existential. Since the same modal operator varies in its interpretation from context to context (e.g., epistemic vs. deontic in (1) and (2)), we need to think of the set of worlds β quantified over as a free pronoun that is assigned value by context through an assignment function. Accordingly, deriving the truth conditions of the modal in (1.a) proceeds as follows.

- (9) a. $\llbracket \text{John must be the culprit} \rrbracket^{w,f,g} =: \llbracket \text{must} \rrbracket (\llbracket \text{John culprit} \rrbracket)$
 $=: \lambda p \in D_{\langle st \rangle} \forall w'. w' \in \text{BEST}_{\leq g} (\cap F_{\text{epis}}(w)) \rightarrow p(w')$
 $=: 1 \text{ iff } \forall w'. w' \in \text{BEST}_{\leq g} (\cap F_{\text{epis}}(w)) \rightarrow \text{John is culprit in } w'$
- b. $\llbracket \text{John may be culprit} \rrbracket^{w,f,g} =: \llbracket \text{must} \rrbracket (\llbracket \text{John culprit} \rrbracket)$
 $=: \lambda p \in D_{\langle st \rangle} \exists w'. w' \in \text{BEST}_{\leq g} (\cap F_{\text{epis}}(w)) \wedge p(w')$
 $=: 1 \text{ iff } \exists w'. w' \in \text{BEST}_{\leq g} (\cap F_{\text{epis}}(w)) \wedge \text{John is the culprit in } w'$

Crosslinguistically, modals vary along two dimensions: they differ in whether the language in question has the quantification force of its modality system encoded in the lexical entry of modals or it has force contextually specified. They also differ in whether the modality flavor (e.g., epistemic, deontic, etc...) is lexically encoded or contextually determined (Matthewson 2010). While most Indo-European languages (e.g., English) lexicalize the quantification force and contextualize the modality flavor, some non-Indo-European languages (e.g., St'át'imcets), however, lexicalizes the force and leaves the modality flavor to the context (c.f., Matthewson 2010 for an investigation into this parameter). Consider the following example from St'át'imcets:

- (10) Context: You have a headache that won't go away, so you go to the doctor. All the tests show negative. There is nothing wrong, so it must be tension.

niłh **k'a** lh(ɛl)-(t)-en -s-w á (7)-(a) ptinus -em-su't
 FOC INTER from-DET-1SG.POSS-NON-IMPF-DET think-MID-OOO
 'It must be from my worrying.'

(Rullmann et al. 2008, 321)

- (11) Context: Maybe that's why he's not here.

wa7 **k'a** se'na7 qwenu'xw
 IMPF INTER COUNTER sick,
 'He may be sick.'

(Rullmann et al. 200, 321)

Interestingly, Standard Arabic (SA) makes use of an instance of context independent modality represented by modal QAD.⁴ Modal QAD is an epistemic-denoting modifier that involves a lexically encoded quantification force with its strength being constrained by the temporal-aspectual properties of QAD's preajacent: QAD's interaction with the (past)perfect/perfective gives rise to the necessity force of quantification and its interaction with the imperfect/prospective results into a possibility force. For example, while the modal QAD in (12) which modifies a perfect/past proposition is interpreted

universally as an assertive modal, the QAD modifiers in (13) that modify propositions in the imperfect/prospective are interpreted as existential epistemic modals.

- (12) *qad qaama Zaydun*
 QAD stand up.PST-3SL.M Zayd-NOM
 ‘Zayd already stood up.’

(Bahloul 2008, 73-74)

- (13) a. *qad yuwaasⁱiluuna s-sayra dʒaaniban*
 QAD continue.PRS-3PL.M DEF-walking aside
wa qad yuwaa sⁱiluuna ad-dawaraana
 may QAD continue.PRS-3PL.M DEF-circling
 ‘They may continue walking on the side, and they may continue turning around.’
- b. *qad yuʔaddii haaḍaa al-qaraaru (. . .) ʔilaa farDi*
 QAD lead.PRS-3PL.M this DEF-decision (. . .) to imposing
ʕuquubaatin mumaddadatin ʕalaa waaridaati al-haafilaati al-yaabaaniyyati
 sanctions strong on imports DEF-buses DEF-Japanes
as-saʕiirati
 DEF-small.

‘this decision may lead to imposing serious sanctions on Japanese imports of mini-buses.’

- c. *qad yakuunu al-waladu yalʕabu*
 QAD be.PRS-3SL.M DEF-boy play.PRS-3SL.M
 ‘The boy might be playing.’
- d. *qad yakuunu al-waladu laʕiba*
 QAD be.PRS-3SL.M the-boy play.PST-3SL.M
 ‘The boy might have played.’
- e. *qad yalʕabu al-waladu alyawma/sadan/*ʔamsi*
 QAD play.PRS-3SL.M the-boy today/tomorrow/*yesterday
 ‘‘The boy might play today/tomorrow/*yesterday.’’

(Bahloul 2008, 123-125)

The data in (12) and (13) show that there is a systematic relation between the quantification force of QAD and the temporal-aspectual properties of the presented proposition. In this way, modal QAD represents a special case of modality that departs from other crosslinguistic cases of modality in its total independency from context.⁵ Unlike English-like modality where the modal base varies across a range of interpretations that are assigned relative to a contextual parameter (Kratzer 1991), modal QAD incorporates an invariable modal base with a fixed epistemic/ expectation or assertive modality meaning. In contrast to St’aʔimcets-like languages which have their quantificational force interpreted relative to context (e.g., relative to a choice function variable which selects a subset of the set of possible worlds that are accessible from the actual world (Rullmann et al. 2008: 319), modal QAD has a lexically-encoded

quantificational force whose strength is constrained by the temporal properties of its prejacent with no interpretive role left for context. The force of modal QAD does not depend on the context in a way or another. But it is lexically specified depending on the temporal realization of the prejacent as shown in Bahloul (2008, 12-13).⁶ The correlation between the strength of modal QAD and tense/aspect is at odds with the traditional view that modality and temporality are distinct categories with complementary distribution. It is more compatible with a uniformitarian view that modality and tense represent major components of every sentence, or at least of QAD sentences in which time systematically constrains the strength of the modal QAD.⁷

Besides, universal QAD triggers what some linguists call "actuality entailment" (Bhatt 1999; Hacquard 2009; Mari 2016).⁸ For example, the three QAD sentences (14) entail the realization of their represented propositions. Notice that actuality entailment does not occur in existential QAD as in (15).

- (14) a. *qad ʔataa* → *ʔataa*
 QAD come.PST-3SL.M → come.PST-3SL.M
 'He has just come.' → 'He came.'
- b. *qad ʔataa ʔamsi* → *ʔataa ʔamsi*
 QAD come.PST-3SL.M yesterday → come.PST-3SL.M yesterday
 'He did come yesterday.' → 'He did come yesterday.'
- c. *kaan-a (qad) katab-a r-risaalat-a*
 be.PST-3SL.M (QAD) write.PST-3SL.M DEF-letter-ACC
lammaa daxal-tu -
 when enter.PST-1SL.M
 'He had (already) written the letter when I entered.'
 → *kaan-a katab-a r-risaalat-a*
 be.PST-3SL.M write.PST-3SL.M the-letter-acc
lammaa daxal-tu
 when enter.PST-1SL.M
 'He had (already) written the letter when I entered.'
- (15) *qad yuʔaddii haaḏaa al-qaraaru (. . .) ʔilaa farDi*
 QAD lead.PRS-3PL.M this DEF-decision (. . .) to imposing
 ʕuquubaatin mumaddadin ʕalaa waaridaati al-haafilaati al-yaabaaniyyati
 sanctions strong on imports DEF-buses DEF-Japanes
 as-saʕiirati
 DEF-small.
 'this decision may lead to imposing serious sanctions on Japanese imports of mini-buses.'
 ↗ *yuʔaddii haaḏaa al-qaraaru (. . .) ʔilaa farDi*
 lead.PRS-3PL.M this DEF-decision (. . .) to imposing
 ʕuquubaatin mumaddadin ʕalaa waaridaati al-haafilaati al-yaabaaniyyati

sanctions strong on imports DEF-buses DEF-Japanes
 as-sabiirati
 DEF-small.

'this decision leads to imposing serious sanctions on Japanese imports of mini-buses.'

This observation is well-attested in goal-oriented, root modals- but not in epistemics (Hacquard, 2009). It has been observed that the root modal in French and Hindi (e.g., ability modal) behaves as an implicative proposition when its presented proposition occurs with the perfective (Bhatt 1999; Hacquard 2009; Mari 2016). Consider (16).

- (16) a. Jane pouvait traverser le lac à la nage, mais elle ne le fit jamais.
 Jane can-past-impf cross the lake by swim, but she it never do-past-pfv.
 b. Jane put traverser le lac à la nage, #mais elle ne le fit pas.
 Jane can-past-pfv cross the lake by swim, #but she it do-past-pfv not.
 'Jane could (was able to) swim across the lake, but she didn't do it.'

Just as other root modals in French and Hindi, universal QAD triggers actuality entailment.⁹ We end up with two forms of QAD: the modalized form and its implicative reading as exemplified in (14), repeated as (17).

- (17) a. *qad* *?ataa* → *?ataa*
 QAD come.PST-3SL.M → come.PST-3SL.M
 'He has just come.' → 'He came.'
 b. *qad* *?ataa* *?amsi* → *?ataa* *?amsi*
 QAD come.PST-3SL.M yesterday → come.PST-3SL.M yesterday
 'He did come yesterday.' → 'He did come yesterday.'
 c. *kaan-a* (*qad*) *katab-a* *r-risaalat-a*
 be.PST-3SL.M (QAD) write.PST-3SL.M DEF-letter-ACC
 lammaa daxal-tu
 when enter.PST-3SL.M
 → *katab-a* *r-risaalat-a* *lammaa* *daxal-tu*
 write.PST-3SL.M DEF-letter-ACC when enter.PST-3SL.
 'He had (already) written the letter when I entered.'

These facts about modal QAD presented a twofold puzzle: the lexically-encoded duality of QAD's strength which is controlled by the temporal-aspectual properties of QAD's preajacent and the fact that universal epistemic QAD expressions are always implicative. The main goal of this paper is to resolve this puzzle by proposing a compositional analysis of modal QAD that explains QAD's lexically-encoded duality of force and its implicative behavior in its universal reading.

This paper is structured as follows. Section one reviews the previous descriptive analyses of particle QAD. We show that none of these analyses are explanatory enough to account for the linguistic behavior of QAD modality. Section two revisits the traditional view that deals with modality and temporality as distinct categories. The section discusses a recent view of tense that gives rise to modality

by reconstructing an α -domain of quantification for modality out of the β -domain of quantification that describes temporality. It also introduces an interval-semantic model for the temporal-aspectual composition, including perfect, past perfect, past tense with perfective and present tense with prospective. In section three, a theory of reliabilism in interaction with the maxim of quality in cooperative speech is advanced and advocated. We argue that a reliability-promoting evidential expression indicates that the claim of its utterance is justified given a cognitive reliability process that involves an evidential requirement. In the last section, we provide a compositional analysis to the facts using the above introduced assumptions. Our analysis works out the two puzzles associated with modal QAD the lexically encoded duality of strength and actuality entailment. The last section concludes the paper.

1. The Descriptive Facts of QAD

Two lines of analysis have been put forth to describe the verbal modifier QAD in Standard Arabic: the one-meaning set of analyses which analyzes QAD as a particle that denotes one of the three meanings of temporality, aspect or modality and the multiple-meaning set that assumes QAD to be a lexically ambiguous expression or an aspect-tense-modality category (i.e., ATM category).¹⁰

On a temporality-based analysis, QAD is a temporal operator that expresses remote perfect or recent past (Wright 1989, Al-Aswad 1983, Er-Rayyaan1986).¹¹ When QAD occurs with the auxiliary verb *kaana* ‘was’, it expresses past perfect. Consider the data in (18).

- (18) a. *qaama* *Zaydun*
 Stand up. PST-3SL.M Zayd-NOM
 ‘Zayd stood up.’
- b. *qad qaama Zaydun*
 QAD stand up. PST-3SL.M Zayd-NOM
 ‘Zayd just stood up.’
- c. *kaana qad ḍakara Khaalidun*
 be. PST-3SL.M QAD mention. PST-3SL.M Khaalid-NOM
maa ḥadath-a
 what happen. PST-3SL.M
 ‘Khaalid had mentioned what happened.’

(Bahloul 2008, 73-74)

An alternative account analyzes QAD as an aspectual marker that denotes terminative or telic event as in (19) (Fradkin 1985, 215–16; Hassan 1990, 127–9).¹²

- (19) a. *la-qad qara?-tu haaḍaa al-kitaab*
 LA-QAD read. PST-1SL.M this DEF-book
 ‘I have (now) read this book.’
- b. *la-qad ḥakmal-tu qiraaḥata-hu*
 LA-QAD finish. PST-1SL.M reading-3SL.M

As observed by Fassi Fehri (2012, 8), the QAD expression in (22) is ambiguous between the modality meaning that denotes factual certainty (i.e., glossed as “indeed”) and temporality which expresses immediate precedence (i.e., glossed as “just”). When QAD occurs with past time adverbials such as *ʔamsi* “yesterday”, it is interpreted unambiguously as an assertive modal. By contrast, the QAD sentence in (21), which modifies a proposition in past perfect, is not modalized; it bears the temporal interpretation of “already or just”.

Although the representative analyses of Bahloul- Fassi Fehri share the same argument that takes QAD as a multi-meaning category, their analyses differ along one crucial dimension: while Bahloul (2008) analyzed QAD as an ATM element with the invariant meaning of assertive modality that may extend to other contextually-determined interpretations depending on the featural dominance of categories such as tense and aspect, Fassi Fehri (2012) oversimplifies the phenomenon by offering an analysis based on lexical ambiguity. Accordingly, QAD has two lexical entries that express tense and modality.

On the Bahloul-Fassi Fehri account, different lexical entries for QAD in its modalized and implicative meaning are in order. This comes at the expense of losing the unifying power of the standard system of modality by extending the ambiguity to other patterns of entailed implicative modality in other languages including French and Hindi. In order to preserve a standard semantics of modality, the previous literature attempts to derive the actuality entailment from the unified theory (Hacquard 2009 and Mari 2016). Therefore, maintaining a lexical ambiguity between temporal, aspectual and modal interpretations is not desirable on theoretical grounds.

2. Tense as a Modality Structure

In this section, we make explicit some standard assumptions about the representation and interpretation of tense that are of specific relevance to our incoming analysis. These working assumptions furnish the basic framework that captures the structural similarity between temporal and modal domains with a formal treatment of tense that gives rise to modality.

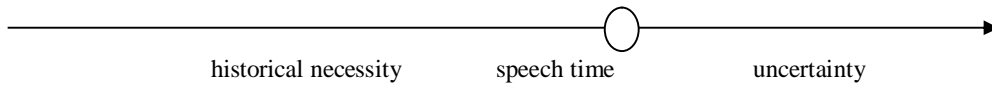
We assume that time is an abstract line that is composed of ordered intervals comprising of points of moments with the following features as outlined in (24):

(24)

- a. The time line consists of the set of all moments M which is represented by the big interval $(-\infty, \infty)$. M comprises the set of closed intervals t such that $t \subseteq T$ (Bennett & Partee 1972).
- b. For every $t \subseteq (M \cup T)$, t is dense: For every m_1, m_2 in t , $m_1 < m_2$ if there is $m_1 + \varepsilon$ such that $m_1 < m_1 + \varepsilon$ and $m_1 + \varepsilon < m_2$ (Fox & Hackl 2006; Sharvit 2014).
- c. Tense is a deictic notion: it relates to a deictic center which is the speech time t^* . (von Stechow 2010)
- d. Time has an asymmetric modal structure that divides what is historically necessary and what is possible or uncertain (Thomason, 1984; Gosselin, 2013).

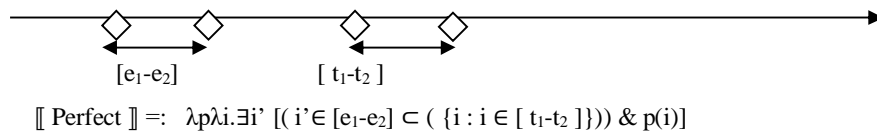
This point of division is represented by the speech time d' .

d' .



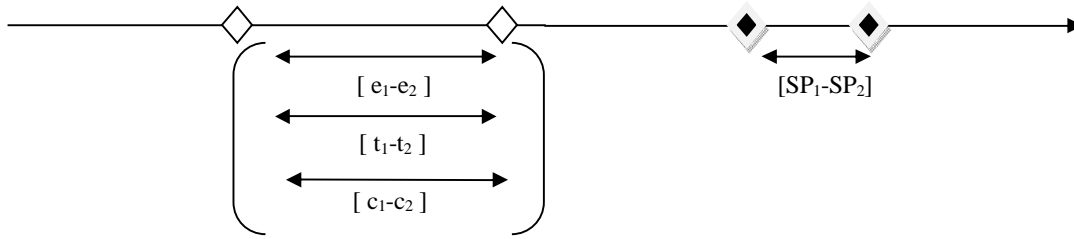
- e. Taking this parallelism between temporal and modal domains as a diachronic consequence of re-categorizing temporality into modality (Iatridou 2000, 246; Schulz 2014), we can reconstruct an epistemic modality frame out of a corresponding temporality frame for the purpose of interpreting the QAD expressions. For example, from the temporality model $\beta = [M, T, <, \subseteq, t^*]$, where M is a set of time points, T is a set of closed interval comprised from M , $<$ is a precedence relation for times and intervals, \subseteq is a subinterval relation and t^* is the speech time interval (see von Stechow, 2010), we can assimilate the modality model $\alpha = [W, I, <, \subseteq, i]$ where W is a set of possible world-time indices, I is the set of closed intervals. $<$ is a precedence relation for indices¹⁶and intervals and \subseteq is a subinterval relation and i is the center of the spheres of the most minimal world-time indices, which corresponds to the actual world-time index (i.e., the index in which the utterance is believed by the speaker to be justifiably true).
- f. The reference time (i.e., past, utterance time) is interpreted pronominally as a contextually-determined free variable, ranging over the past and utterance times as follows.
- f'. i. $\llbracket \text{past}_{j,k} \rrbracket^h$ is defined for every $h(j)$ and $h(k) \in D_t$ and $h(k) < h(j)$, when defined, $\llbracket \text{past}_{j,k} \rrbracket^h := h(k)$
- ii. $\llbracket \text{present}_{j,k} \rrbracket^h$ is defined for every $h(j)$ and $h(k) \in D_t$ and $h(k) \geq h(j)$, when defined, $\llbracket \text{past}_{j,k} \rrbracket^h := h(k)$ (Partee 1973, Sharvit, 2014).^{17 18}
- g. We adopt a Reichenbach model with its coordinates replaced by intervals. We differentiate four temporal intervals : The event time interval $[e_1-e_2]$ that corresponds to the categorization and construction of an eventuality, the reference time or the tense interval $[t_1-t_2]$, the speech time $[SP_1-SP_2]$ and the circumstantial time that is signaled by the presence of the adverbial $[c_1-c_2]$.
- h. We focus on four aspectual relations. The first is the perfect in which the event time interval precedes the reference time interval. The second is the past tense with perfective aspect in which the event tense and circumstantial intervals coincide. The third is the past tense with the perfect viewpoint in which both the circumstantial and event time intervals precede the reference time interval. Finally, the prospective viewpoint in which the event time interval follows the reference time interval. The four temporal-aspectual relations:

h' i. Perfect viewpoint



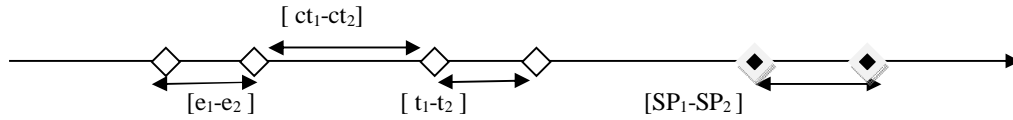
ii. Past tense with Perfective viewpoint

The Semantics of Modal QAD in Standard Arabic



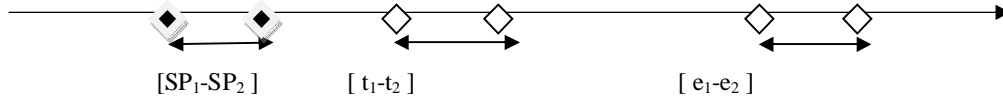
$$\llbracket \text{Past Perfective} \rrbracket =: \lambda p \lambda i. \exists i' \exists i''. [i' \in [e_1-e_2] \subseteq (\{i : i \in [t_1-t_2] \ \& \ i < [SP_1-SP_2]\} \ \& \ i \subseteq \{i'' : i'' \in [c_1-c_2]\})] \ \& \ p(i)$$

iii. Past tense with perfect viewpoint



$$\llbracket \text{Past Perfect} \rrbracket =: \lambda p \lambda i. \exists i'. [i' \in [e_1-e_2] \subseteq (\{i : i \in [t_1-t_2] \ \& \ i < [SP_1-SP_2]\}) \ \& \ p(i)]$$

iv. Present tense with prospective viewpoint



$$\llbracket \text{Present Prospective} \rrbracket =: \lambda p \lambda i. \exists i'. [(\{i : i \in [t_1-t_2] \ \& \ i \geq [SP_1-SP_2]\}) \subseteq i' \in [e_1-e_2] \ \& \ p(i)]$$

At this point, we will digress briefly and devote the next two sections to explaining some key notions and working assumptions about reliability and evidentiality in QAD-modality. By the end of the short digression, the reader should keep in mind the modal-temporal framework that has been furnished in this section. Once the three notions of time, reliability and evidentiality are introduced and demonstrated, we will have ready the basic ingredients of our proposal, which aims at resolving the twofold puzzle of QAD modality represented by the lexically specified duality of strength and the actuality entailment of its universal reading.

3. Reliability in Cooperative Speech

Rational speakers observe the conditions of cooperative conversation or what Grice (1975) called “the cooperative principle”. This principle integrates the maxims or sub-maxims of rational cooperative conversation that maintain informativeness, truth, relevance and clarity in conversational exchanges. As far as the maxim of quality is concerned, the speaker **S** utters proposition **p** only if **S** believes that **p** is true and **S** has adequate evidence for the truth of **p** (Grice 1975, 27).

For non-evidential utterances in (25) (= non-modalized utterances where evidence for truth is not part of its meaning), we assume, following Goldman (1976), that **S** arrives at a *belief that p* on the basis of perceptual experience that enables **S** to discriminate the truth of **p** from all relevant alternatives. Once the speaker arrives at a *belief that p at t* through a reliable cognitive belief-forming process (or set of

processes), her belief is justified (Goldman 1976). In uttering (25.a), the speaker does not assign any reliability to the claim that Zayd stood up: the speaker is not in a position to justify that her belief that (25) is true. The speaker, however, utters what she believes it's justifiably true and the hearer assumes that the speaker is expected to be cooperative in having every good reason to believe that the utterance is true in compliance with quality.

- (25) a. *qaama* *Zayd-un*
 stood up.PST-3SL.M Zayd-NOM
 'Zayd stood up
- b. *qad qaama* *Zayd-un*
 QAD stood up.PST-3SL.M Zayd-NOM
 'Zayd just stood up.'

In epistemic-based or expectation-denoting utterances like modal QAD in (25.b), the speaker indicates that the truth of **p** is justified. The speaker commits herself not to the truth of the proposition in (25.b), but to raising the reliability of its truth by utilizing notions that do not appeal to "epistemically normative concepts" such as the justification concept itself, reasonability or rationality (Goldman 1976). Put it differently, in the reliability-promoting utterances in (15.b), the speaker makes an epistemic status of the **belief that p** depending on particular mental or psychological processes that justify **p**.

Following Comesaña (2010), we assume that a justification process that raises reliability satisfies an evidential requirement. That is, the speaker's **belief that p** should be produced by a process X that is either reliable in such a way that X contains evidence *e* which is devoid of any beliefs of the speaker or conditionally reliable such that it contains evidence *e* that integrates justified beliefs of the speaker. It follows that the mental or psychological states that reliability processes invoke can only be fed by inputs that are either doxastic states that include fully justified beliefs or non-epistemic states such as perceptual experiences. As long as the notion of evidence is understood as a mental process in terms of these inputs, they may be identified as legitimate inputs into the mental processes of reliability (Comesaña 2010).

3 It's worth mentioning that this view on reliabilism has a historical dimension: the formation of an epistemic status in **a world w at time t** utilizes not only what evidence that the agent has already acquired at *t*, but also the evidential history that is accessible from *w* up to *t* (Goldman 1999). Adopting this line of argument, we follow and extend a theory of linguistic reliabilism that amalgamates the following features:

- (26) a. The speaker utters what she believes to be justifiably true in compliance with quality (Grice 1975).
 b. In reliability-promoting utterance (e.g., QAD-modality), the speaker commits herself to raising the reliability of truth of her claim in view of legitimate evidence (= non-epistemic or justified beliefs) (Comesaña 2010).
 c. In presence of relevant, legitimate evidence, the speaker utilizes as much space of relevant evidential history as possible to make her utterance more reliable. Put it formally, the speaker draws on the whole linear subset Γ of the world-time indices that represents the relevant evidential history (i.e., such that for all $i, i' \in \Gamma$, either $i' \leq i$ or $i \leq i'$), resulting in a strong interpretation of the modal (i.e., necessity)

- d. When utilizing the whole evidential history is inapplicable (i.e., quantifying over open domains (see Fox and Hackl 2006)), satisfying the evidential history proceeds by quantifying over a smaller subset of a linear subset I' of the world-time indices that represents the relevant evidential history, resulting into a weaker interpretation of the modal (i.e., possibility).

4. The Evidential Requirement in QAD-expression

We closed the previous section with two assumptions: (i) raising reliability involves an evidential requirement and (ii) QAD-expressions incorporate a condition of maximal informativeness as motivated by quality. That is, the speaker uses the best (maximal sum) of available evidence to make his utterance most reliable. In reliability-raising expressions, the evidential requirement may be satisfied on the part of the speaker by following two obligatorily intuitive strategies:

- (27) a. In necessarily closed evidential history (i.e. indices of tense intervals), the speaker utilizes the whole body of historically accessible evidence. On the assumption that past and perfect temporal domains have an upper bound i , quantification targets the entire set of the evidential history that is foreclosed by I , resulting into a universal interpretation of the past/perfect QAD-expressions.¹⁹
- b. In necessarily open intervals, quantification is not performed on the whole space of relevant evidential history.²⁰ To satisfy the evidential requirement, quantification involves a proper subset of the open evidential history, resulting into a weaker interpretation of the imperfect/prospective QAD-expressions.

Let us discuss these two strategies with an illustration to make the picture clearer. Consider (28).

- (28) a. *taxradʒ* *Zayd-un*
graduate. PST-3SL.M *Zayd-NOM*
'Zayd graduated.'
- b. *qad taxradʒ* *Zayd-un*
QAD graduate. PST-3SL.M *Zayd-NOM*
'Zayd did graduated.'

The example in (28.b) has the denotation that Zayd's graduation is expected/asserted by the speaker in all possible world-time indices in view of available evidence (i.e., historical necessity). Assume an abstract scale of reliability with degrees that correspond to the evidence pieces that are acquired by the speaker in the reliability-assigning process for the relevant eventuality. Assume further a non-deterministic view of the universe (Ippolito 2013; contra to Lewis 1979).²¹ As we proceed to claim that (28.b) involves tense with the modality-denoting meaning of expectation, we can reconstruct a modality domain α (= world-time indices) out of the past tense domain β (= times) for (28.b). The LFs in (29) represent the presented proposition in (28), using the modal and temporal domains for (27.a,b), respectively.

- (29) a. $\llbracket \text{graduated Zayd past}_i \rrbracket^{\text{e}} = 1$ iff graduate (Ali) at $g(i)$, where $g(i) < t^*$
- b. $\llbracket \text{graduated Zayd past}_i \rrbracket^{\text{e}} = 1$ iff graduate(Zayd) in i^* , where $i^* < i$

such that i^* is a world-time equivalence class for the reference time $g(i)$ and i is a world-time equivalence class for the deictic temporal center t^*).

On the temporal interpretation in (29.b), the sentence indicates that the eventuality described took place at $g(i)$, which is the time interval located before the speech time t^* , with the belief that the claim described is true in compliance with quality. On the corresponding modality interpretation, the speaker utters the sentence in i^* which represents the most expected, most reliable world-time index in which the claim holds true, given historically accessible evidence.

Under quality, the speaker respects the quality maxim of what she believes to be true by promoting the reliability of her claim to the uppermost point possible that represents the evidential history available. On the assumption that evidence pieces stand for reliability degrees (e) with a non-deterministic view of the universe, we can identify the following upward monotone property that holds of the prejacent p in (30).

(30) For every $e_1, e_2 \subseteq D_{\langle st \rangle}$, let d_1 be $\cap e_1$ and d_2 be $\cap(e_1 \cup e_2)$ then $d_1 < d_2$ iff d_2 asymmetrically entails d_1 .

Assume that the speaker utters (28.b) on the basis of three pieces of evidence: $e_1 = \text{that Ali finished the writing of his dissertation}$, $e_2 = \text{that he received positive feedback from his advisor on the final draft of his dissertation}$ and $e_3 = \text{that he defended his dissertation successfully}$. It is understood that $\cap(e_1 \cup e_2 \cup e_3)$ asymmetrically entails $\cap(e_1 \cup e_2)$, which in return asymmetrically entails $\cap(e_1)$. It follows that $\cap(e_1 \cup e_2)$ is more informative than $\cap(e_1)$ and $\cap(e_1 \cup e_2 \cup e_3)$ is the most informative of all in terms of reliability. Given this upward monotonicity that characterizes the property of *qad*-expressions along the lines of an abstract reliability scale, we can distinguish two types of intervals which QAD quantifies over as in (31).

(31)

- a. For every $p \in D_{\langle st \rangle}$ and every $e_1, e_2, e_3 \subseteq D_{\langle st \rangle}$ and every $\cap e \in D_{\langle st \rangle}$, let d_1 be $\cap e_1$, d_2 be $\cap(e_1 \cup e_2)$, d_3 be $\cap(e_1 \cup e_2 \cup e_3)$ and the past-perfect interval [P-P] be $(\lambda d. p(d)(i))$ (i.e., $[0, d_1, d_2, d_3]$). Given upward monotonicity, we can define a necessarily closed interval of the past-perfect α domain of quantification [P-P] as follows: for every $i^* \leq i$, it is the case that $d_1 < d_2 < d_3$ iff $p(d_3)=1$ and $p(d_3)$ asymmetrically entails $p(d_2)$ and $p(d_1)$ and it follows that $p(d_2)=1$ and $p(d_1)=1$. Assume $d_4 \notin$ (P-P), then there is i' such that $i' > i^*$ in which $p(d_4)=0$. This means that the [P-P] is necessarily a closed interval.
- b. For every $p \in D_{\langle st \rangle}$ and every $e_1, e_2, e_3 \subseteq D_{\langle st \rangle}$ and every $\cap e \in D_{\langle st \rangle}$, let d_1 be $\cap e_1$, d_2 be $\cap(e_1 \cup e_2)$, d_3 be $\cap(e_1 \cup e_2 \cup e_3)$ and the present-future interval [P-f] be $(\lambda d. p(d)(i))$ (i.e., $[0, d_1, d_2, d_3]$). Given upward monotonicity, we can define a necessarily open interval of the present-future α domain of quantification (P-F) as follows: For every $i^* \geq i$, it is the case that $d_1 < d_2 < d_3$, if $p(d_3)=1$ and $p(d_3)$ asymmetrically entails $p(d_2)$ and $p(d_1)$, and it follows that $p(d_2)=1$ and $p(d_1)=1$. Assume $d_4 \notin$ (P-F), then we cannot predict that there is i' such that $i' > i$ in which $p(d_4)=0$, since the above condition holds for every $i^* \geq i$. This means that the [P-F] is necessarily an open interval.

5. The Proposal

In this paper, we use the standard framework of the generative, type-theoretic semantics as standardized in Heim and Kratzer (1998). Following the tradition, we will assume that the syntax proper transfers natural language expressions to the Logical Form component where the compositional rules of construal translate these syntactic expressions into specialized meta-language expressions that encode relevant interpretations.

5.1. QAD as a speaker-oriented and time-insensitive modal

2 Unlike root modals, QAD is an epistemic that conveys the modality meaning of expectation. It reflects the speaker judgment about the presented proposition and it is evaluated relative to the time of speech, rather than the tense of its proposition (Haquard 2011).²² In QAD-modality, the speaker assigns some degree of reliability to the piece of knowledge that is described by the utterance on the basis of historically accessible evidence or inductive reasoning. Depending on the temporal-aspectual properties of the prejacent, the speaker assigns the necessity force of assertion to the relevant eventuality of modal QAD when its prejacent is in the (past)perfect/ perfective and the possibility force of expectation when the prejacent is in the imperfect/prospective (Bahloul 2008). In what follows, we will introduce the empirical findings and working assumptions about QAD with the relevant terminology being explained.

(32)

- a. Following Dahl and Talmoudi (1979), we assume that modal QAD promotes reliability in view of the evidential history of its presented proposition.
- b. The past (perfect)/ perfective satisfies a boundedness condition in two ways: in the presence of a past tense adverb, the set of indices introduced by the adverb serve as the upper bound of the event as described by QAD's prejacent. Otherwise, it is the speech time interval [SP₁- SP₂] that marks the upper bound of the event. Quantification proceeds over the entire interval of the bounded evidential history.
- c. The imperfect/prospective QAD expressions introduce unbounded evidential histories so that quantification proceeds over a proper subset of the indices of the unbounded evidential history.

4d. $\llbracket \text{qad} \rrbracket$ acts as an illocutionary operator that raises the reliability of the truth of the presented proposition: it is a speech act operator that applies to truth conditional propositions to yield an actional meaning (Stenius 1967, Krifka 2014).²³ Supporting evidence for the illocutionary nature of QAD comes from the fact that it cannot be embedded under other scope-bearing operators such as temporal, negative, interrogative and conditional (Trumpp 1881, Worrell 1908, Rockendorf 1921 Kinberg, 2001) as shown in (33-37).²⁴

(33) *Lammaa (*qad) dzaaʔ-a Muhammad-un xaradʒ-naa*
 after/when (*QAD) come.PST.3SL.M Muhammed-NOM leave.PST.3SL.M
 'We left when Muhammed came.' (Bahlul 2008, 85)

(34) *ʕindamaa (*qad) istayqad-naa badaʔ-naa l-ʕamal-a*
 as soon as (QAD) wake up.PST.3PL.M start-PST.3PL.M DEF-work.ACC
 'We started working as soon as we woke up.' (Bahloul 2008, 85)

- (35) *Ma (*qad) dzaa?-a Zayd-un*
 no (QAD) come.PST.3SL.M Zayd-NOM
 ‘Zayd did not come.’ (Rockendorf 1921, 303)
- (36) *mataa (*qad) nama Ali?*
 when (QAD) sleep.PST.3SL.M Ali?
 ‘When did Ali sleep?’ (Worrell 1908, 135)
- (37) *in (*qad) tadrus tandzħ*
 If (QAD) study.PRS.3SL.M, succeed.PRS.3SL.M
 ‘If you study, you succeed.’ (Trumpp 1881, 366)

5.2. A Compositional Analysis

Since $\llbracket \text{qad} \rrbracket$ is not a regular semantic object as evidenced by the fact that $\llbracket \text{qad} \rrbracket$ cannot be embedded under other scope-bearing truth conditional operators in (33-37), we assume that $\llbracket \text{qad} \rrbracket$ is a speech act operator. Following Szabolcsi (1982) and Krifka (2014), we analyze speech acts as operators that change the commitments of conversational participants: they change a world-time index at which the actional meaning of the utterance (e.g., promise, assertion, etc...) doesn’t hold to the world-time index at which such an actional meaning holds. $\llbracket \text{qad} \rrbracket$ then is a speech act operator that applies to truth-conditional propositions and transforms them into an actional meaning in which the speaker raises the reliability of the truth of the utterance in view of its evidential history.

We interpret modal $\llbracket \text{qad} \rrbracket^i$ relative to a reconstructed modality model $\alpha = [I, <, \sqsubseteq, i]$ where W is a set of possible world-time indices, I is the set of closed intervals, $<$ a precedence relation for indices and intervals, \sqsubseteq is a subinterval relation and i is the center of the spheres of world-time indices that the speaker considers the most minimal (= the index in which the utterance is believed by the speaker to be justifiably true or the index in which the utterance has its reliability of truth raised to its uttermost degree).

We suggest that the $\llbracket \text{qad} \rrbracket^i$ operator takes three arguments: a context-denoting variable of type $\langle c \rangle$ that specifies the value of the speaker, addressee and world-time index, a proposition P that denotes a predicate of indices of type $\langle it \rangle$, and a closed interval-denoting object I of type $\langle it \rangle$ and it yields the truth value if and only if the speaker c_s raises the reliability of the truth of the proposition p towards the addressee c_a at c_t as represented in (38).

$$(38) \llbracket \text{qad} \rrbracket^{c,i} =: \lambda c \in D_{\langle c \rangle} \lambda p \in D_{\langle it \rangle} \lambda I \in D_{\langle it \rangle} \cdot i^1 [c_t = i^1 \ \& \ \max(I) < i \ \text{and} \ \text{Rel}(i^1)(p)]$$

(c_s) (c_a)

Given the following definitions:

- c is a context-denoting variable whose value is specified for the world-time index c_t in which the speaker c_s raises the reliability of the truth of utterance towards and addressee c_a
- $\max(I)$ is the unique $i^1 \in I$ such that for all $i^0 \in I$ $i^1 \geq i^0$
- $\text{and} <$ is a strict total order in which $\max(I) < i^1$ if $\max(I) \leq i^1$ & $\max(I) \neq i^1$ and if not $i^1 \leq \max(I)$

(To be revised)

Since modal QAD incorporates an epistemic-based modality with its universal meaning expressing historical necessity that triggers an actuality entailment and its existential meaning expressing an epistemic -based possibility, we propose that the meaning of $\llbracket \text{qad} \rrbracket$ presupposes a modality meaning. We suggest that the lexical entry of $\llbracket \text{qad} \rrbracket$ has a lexically hardwired modality meaning that consists of two components: first, a historical modal base H , which is represented as a function from a time-world-index i into sets of propositions in which evidential history is expressed up to i as represented in (39).²⁵

$$(39) \ h(i) =: \{ p : p \text{ is a proposition such that the evidential history is expressed up to } i \}$$

(= where i is the time-world index of evaluation that denotes the actual time-world of the speech time)

Since the set of propositions in (30) denote the set of sets of worlds in which the proposition such that evidential history is expressed up to i are true, intersecting this set yields the following set:

$$(41) \ \cap h(i) =: \{ i' : i' \text{ is a time-world index in which all the propositions that the evidential history obtains up to } i \text{ hold true} \}$$

The other component is a modal choice function that picks out a non-empty particular subset of historically-accessible set of worlds (Reinhart 1997; Rullmann et al. 2008). Such a choice function picks out a non-empty subset of a relevant evidential history.²⁶ It is then a function from I of type $\langle it \rangle$ into a subset of I of type $\langle it \rangle$ as described in (41):

$$(41) \ \llbracket f \rrbracket =: \forall I \in D_{\langle it \rangle} . f(I) \subseteq I$$

This choice function has two properties: first, it produces a non-empty subset of I . Second it is optimizing in the sense that it operates on as much evidential history as it can to satisfy the evidential requirement of reliability.

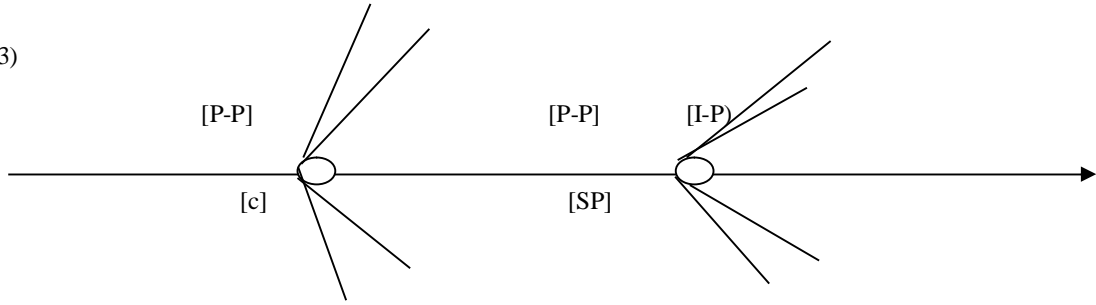
Given these components, the $\llbracket \text{qad} \rrbracket$ operator has the following lexical entry with a default universal modality component:

$$(42) \ \llbracket \text{qad} \rrbracket^{c_i} =: \lambda c \in D_{\langle c \rangle} \lambda p \in D_{\langle it \rangle} \lambda I \in D_{\langle it \rangle} . \text{u}^1[c_i = i^1 \ \& \ \max(I) < i^1 \ \& \ \text{Rel}(i^1) \ \& \ \forall i' [i' \in \cap h(i) \rightarrow p(i')] (c_s) (c_a)]$$

The QAD operator takes a proposition of type $\langle it \rangle$ and introduces the unique i^1 which is equivalent to the world-time index c_i at which the speaker (c_s) raises the reliability of the claim that is described by the property p towards the addressee (c_a). Raising reliability proceeds in view of every possible accessible world-time index that is compatible with the evidential history of the utterance and at which the proposition p holds true up to the actual time-world of the speech time i .

We propose that QAD operates on two types of evidential histories: a bounded (past) perfect/perfective α domain of quantification [P-P] which is a necessarily closed interval. It represents an evidential history that is closed by the upper bound of the circumstantial time $[c_1-c_2]$ or the speech time interval $[SP_1-SP_2]$ and a necessarily open interval that corresponds to imperfect/prospective α domain of quantification [I-P], which represents an evidential history that has no upper bound, as schematized in (43).²⁷

(43)



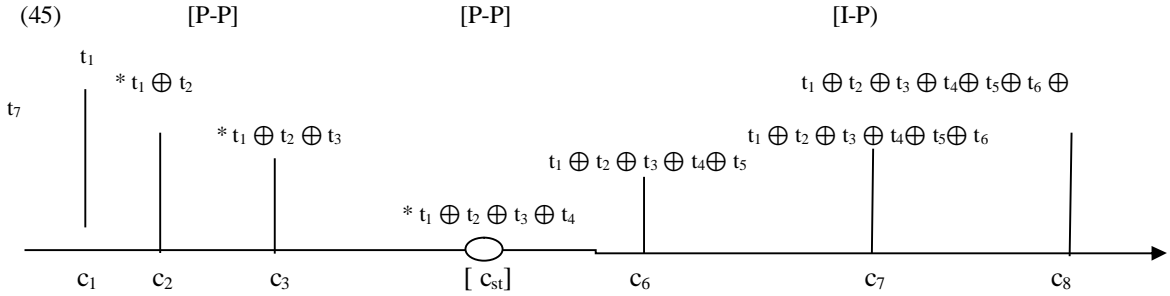
To explain the schema in (43), we adopt a simplified version of the Modal-Temporal Skeleton (Thomason 1984, Mari 2010) that generates a branching structure with a unique bounded [c] and [SP] and an open future. Each branching point is unique in the sense that the interval [P-P] undergoes pluralization and maximization at past times [c] and speech time [SP].

To formalize the idea, we assume the complete join semilattice structure $\langle I_{atom}, \oplus, \sqsubseteq, p \rangle$ to derive a unique pluralized maximal value for the past and present times (Link 1983, Landman 1989, Elbert et al. 2014, 392).²⁸ Accordingly, pluralizing and maximizing [P-P] involves the application of $*$ and σ operators, respectively as represented in (44).

(44) For any [P-P] $\in D_{\langle it \rangle}$,

- a. $\llbracket * [P-P] \rrbracket^{c,i} =: \{ i \in I : \exists Y \subseteq \llbracket [P-P] \rrbracket^{c,i} \ \& \ i = \bigoplus Y \}$
- b. $\llbracket \sigma [P-P] \rrbracket^{c,i} =: i$ such that $i \in \llbracket * [P-P] \rrbracket^{c,i}$ and $\forall i' \in \llbracket * [P-P] \rrbracket^{c,i} : i' \sqsubseteq i$

Assume that the [P-P] is the set $\{i_1, i_2, i_3\}$. Pluralizing [P-P] at $[c_3]$ yields the set $\{i_1, i_2, i_3, i_1 \oplus i_2 \oplus i_3\}$ and maximizing [P-P] at $[c_3]$ produces the singleton set $\{i_1 \oplus i_2 \oplus i_3\}$. Similarly, Pluralizing [P-P] at $[c_{st}]$ yields the set $\{i_1, i_2, i_3, i_4, i_1 \oplus i_2 \oplus i_3 \oplus i_4\}$ and maximizing such an interval produces the singleton set $\{i_1 \oplus i_2 \oplus i_3 \oplus i_4\}$. This amounts to saying that at $[c_3]$, we have only accessible the unique $t_1 \oplus t_2 \oplus t_3$ and at the speech time $[c_{st}]$, only the unique $i_1 \oplus i_2 \oplus i_3 \oplus i_4$ is accessible. Notice that the open interval [I-S] can be pluralized but it cannot be maximized.²⁹



Recall our conjecture that reliability has an evidential requirement: the maxim of quality holds that the speaker utters what she believes to be true for what she has evidence for (Grice, 1975). In reliability-promoting expressions such as modal QAD, the speaker utilizes as much relevant evidence as she has to raise the reliability of her utterance.

On the assumption that the branching structure in (45) has unique bounded past [c] and [SP] and an open future, the speech time [SP] and the preceding past [c] represent branching points where the closed interval [P-P] undergoes pluralization and maximization. In (45), the evidential history [P-P] is pluralized and maximalized at speech time $[c_{st}]$ and it does so at each past time (e.g., c_1, c_2, c_3) that precedes the

speech time $[c_{st}]$. Notice that the [I-p] cannot be maximized at the future times (e.g., c_6, c_7, c_8) since these represent open intervals. As such, we end up with the two types of sets of indices that underlie the evidential histories at each branching point: a singleton set that includes the unique pluralized-maximized element of the [P-P] at speech time c_{st} and any other c that precedes speech time c_{st} and a non-singelton set that consists of a number of indices that can be pluralized, but not maximized, at any other c that follows speech time c_{st} .

- (46) a. At c_2 [P-P] =: $\{ *t_1 \oplus t_2 \}$
 b. At c_3 [P-P] =: $\{ *t_1 \oplus t_2 \oplus t_3 \}$
 c. At c_{st} [P-P] =: $\{ *t_1 \oplus t_2 \oplus t_3 \oplus t_4 \}$
- (47) a. At c_6 [I-P] =: $\{ i_1, i_2, i_3, i_4, t_5, i_1 \oplus i_2 \oplus i_3 \oplus i_4 \oplus t_5 \}$
 b. At c_7 [I-P] =: $\{ i_1, i_2, i_3, i_4, t_5, t_6, i_1 \oplus i_2 \oplus i_3 \oplus i_4 \oplus t_5 \oplus t_6 \}$
 c. At c_8 [I-P] =: $\{ i_1, i_2, i_3, i_4, t_5, t_6, t_7, i_1 \oplus i_2 \oplus i_3 \oplus i_4 \oplus t_5 \oplus t_6 \oplus t_7 \}$

With this background in mind, let us see how we can derive the lexically-encoded quantificational force of QAD depending on the temporal-aspectual properties of its prejacent. Let us look first at the universal QAD in (48).

- (48) *qad taxradz* *Zayd-un* (Universal Reading)
 QAD graduate.PST-3SLM *Zayd-NOM*
 'Zayd did graduated.'

First, the operator QAD applies to its prejacent the proposition p *taaxraj Zayd-un* 'Zayd graduated.', yielding a historical necessity. Since p is in the perfect, it introduces a bounded α domain of quantification as represented in (49).

- (49) $\llbracket \text{Zayd graduated} \rrbracket =: \llbracket \text{Past Perfect} \rrbracket (\llbracket \text{Zayd graduated} \rrbracket)$
 $=: \lambda p \lambda i^t. \exists i^e [(i^e \in [e_1-e_2] \subset (\{i^t: i^t \in [t_1-t_2] \})) \& p(i^t)] (\lambda i. \text{Zayd graduate at } i)$
 $=: \lambda i^t. \exists i^e [(i^e \in [e_1-e_2] \subset (\{i^t: i^t \in [t_1-t_2] \})) \& \text{Zayd graduate in } i^t]$

Plugging the bounded predicate of indices p into the QAD operator gives the following output:

- (50) $\llbracket \text{QAD Zayd graduated} \rrbracket =: \llbracket \text{qad} \rrbracket^{c,i} (\llbracket 49 \rrbracket)$
 $=: \lambda c \in D_{\langle c \rangle} \lambda p \in D_{\langle i^t \rangle} \lambda i \in D_{\langle i^t \rangle} . u[c_t = i \& \max(I) < i \text{ and } \text{Rel}(i) \& \forall i' [i' \in f(H(i)) \rightarrow p(i')]$
 $(c_s) (c_a) [\lambda i^t. \exists i^e [(i^e \in [e_1-e_2] \subset (\{i^t: i^t \in [t_1-t_2] \})) \& \text{Zayd graduate in } i^t]$
 $=: 1 \text{ iff } \lambda c \in D_{\langle c \rangle} \lambda i \in D_{\langle i^t \rangle} . u[c_t = i \& \max(I) < i \text{ and } \text{Rel}(i) \& \forall i' [i' \in f(H(i)) \rightarrow \exists i^e [(i^e \in [e_1-e_2] \subset (\{i^t: i^t \in [t_1-t_2] \& i' < [SP_1-SP_2] \})) \& \text{Zayd graduate in } i^t]] (c_s) (c_a)$

The choice function of the modality component f in (42) necessarily gives rise to an identity function when applying to bounded α domain of quantification (i.e., (past) perfect/ perfective [P-P]): since the perfect introduces an evidential history with a singleton set of indices that comprises the unique pluralized-maximized index at speech time $\{ *t_1 \oplus t_2 \oplus t_3 \oplus t_4 \}$, the choice function f takes as its argument this singleton set and produces the set of unique pluralized-maximized index $\{ *t_1 \oplus t_2 \oplus t_3 \oplus t_4 \}$. It is then an identity function that gives rise to a universal reading.

The truth conditions in (44) correctly predict the fact that the universal QAD expression triggers an actuality entailment. The modality component of QAD is evaluated at the time-world index i which is equivalent to $* t_1 \oplus t_2 \oplus t_3 \oplus t_4$ that stands for the actual world. As in the truth value in (44), the time-world index of the event of QAD's prejacent i^e belongs to the time-world index of the tense of QAD'S prejacent i' which is entailed by the time-world index $* t_1 \oplus t_2 \oplus t_3 \oplus t_4$ of the evaluation time of the modality component of QAD as in (51):

$$(51) \quad i_e \subset i'$$

$$i' \subset * t_1 \oplus t_2 \oplus t_3 \oplus t_4$$

$$i_e \subset * t_1 \oplus t_2 \oplus t_3 \oplus t_4$$

Since the event index belongs to the unique index $* t_1 \oplus t_2 \oplus t_3 \oplus t_4$ of the actual world, an actuality entailment automatically arises with universal QAD.

Consider now the existential QAD expression in (52)

$$(52) \quad qad \quad ya-taxrad\zeta \quad Zayd-un \quad (\text{Existential Reading})$$

QAD graduate.PRS.3SL.M Zayed.NOM

‘Zayd may graduate.’

In (52), the operator QAD applies to its prejacent the proposition $p \quad ya-taxrad\zeta \quad Zayd-un$ ‘Zayd graduates.’, yielding an epistemic possibility as represented in (53)

$$(53) \quad a. \quad \llbracket \text{Zayd graduates} \rrbracket =: \llbracket \text{Prospective} \rrbracket (\llbracket \text{Zayd graduate} \rrbracket)$$

$$=: \lambda p \lambda i^t. \exists i^e. [(\{i^t : i^t \in [t_1-t_2] \ \& \ i^t > [SP_1-SP_2]\}) \subset i^e \in [e_1-e_2]] \ \& \ p(i^t)] \quad ([\lambda i.$$

$$\quad \text{Zayd graduate at } i])$$

$$=: \lambda i^t. \exists i^e. [(\{i^t : i^t \in [t_1-t_2] \ \& \ i^t > [SP_1-SP_2]\}) \subset i^e \in [e_1-e_2]] \ \& \ \text{Zayd graduate}$$

$$\quad \text{at } i^t]$$

$$b. \quad \llbracket \text{QAD Zayd graduates} \rrbracket =: \llbracket qad \rrbracket^{e,i} (\llbracket 53 \rrbracket)$$

$$=: \lambda c \in D_{\langle c \rangle}. \lambda p \in D_{\langle i \rangle}. \lambda I \in D_{\langle i \rangle}. \quad u_i[c_i = i \ \& \ \max(I) < i \ \& \ \text{Rel}(i) \ \& \ \forall i' [i' \in$$

$$\quad f(H(i)) \rightarrow p(i')] \quad (c_s) \quad (c_a) \quad (\lambda i^t. \exists i^e. [(\{i^t : i^t \in [t_1-t_2] \ \& \ i^t > [SP_1-SP_2]\}) \subset i^e \in$$

$$\quad [e_1-e_2]] \ \& \ \text{Zayd graduate at } i^t])$$

$$=: 1 \text{ iff } \lambda c \in D_{\langle c \rangle}. \lambda I \in D_{\langle i \rangle}. \quad u_i[c_i = i \ \& \ \max(I) < i \ \& \ \text{Rel}(i) \ \& \ \forall i' [i' \in f(H(i))$$

$$\quad \rightarrow \exists i^e. [(\{i^t : i^t \in [t_1-t_2] \ \& \ i^t > [SP_1-SP_2]\}) \subset i^e \in [e_1-e_2]] \ \& \ \text{Zayd}$$

$$\quad \text{graduate at } i^t] \quad (c_s) \quad (c_a)]$$

On the assumption that the imperfect/prospective (i.e.,[I-P]) in (53) introduces an open unbounded α domain of quantification, the choice function f necessarily selects a subset of indices that is made available for quantification: the choice function f cannot map every possible world-time index in an open evidential history. With a subset of relevant indices quantified over, the default universal modality component of QAD is lexically weakened and an existential reading of modal QAD in (46) arises.

The semantics in (53) also predicts the fact that the imperfect/prospective QAD never gives rise to actuality entailment. First, the prejacent is evaluated at an index i' that follows the unique index $* t_1 \oplus t_2 \oplus t_3 \oplus t_4$ of the actual word. Second, the two indices and whatever indices occur between the two

indices by density belong to the time-world index of the event of QAD's prejacent i_e and such an index i' entails the event time of the prejacent.

$$(54) \quad * t_1 \oplus t_2 \oplus t_3 \oplus t_4 < t_1 \oplus t_2 \oplus t_3 \oplus t_4 \oplus t_{4+n} < i' \subset i_e$$

It follows that the event i_e of the prejacent may not be exclusively true in $* t_1 \oplus t_2 \oplus t_3 \oplus t_4$ of the actual world and hence implicativity of the event disappears.

6. Conclusion

The linguistic behavior of modal QAD in Standard Arabic presents a twofold puzzle: first, modal QAD involves an unambiguous epistemic modal base and a lexically-specified quantification force with its strength being systematically constrained by the temporal properties of qad's prejacent. Second, modal qad in its universal reading triggers actuality entailment. We proposed a compositional truth conditional interval semantics to account for these observations. In this way we preserve the unifying power of the theory by proposing a standard semantics for QAD, which is explanatory enough to account for the two puzzles of time-sensitive duality of strength and the actuality entailment.

دلالة الأداة "قد" في اللغة العربية

عبد الرحمن أبو هلال

قسم اللغة الإنجليزية وآدابها، جامعة الزيتونة الأردنية، الأردن

الملخص

يوجد مسألتان منطقيتان تتعلقان بدلالة الأداة "قد" في اللغة العربية، أولاً: الأداة "قد" تصف مكنون المعرفة الذاتية للمتكلم حول حدث ما بقوة كلية تفيد التحقيق، وأخرى جزئية تفيد الاحتمال. هذه القوة ترتبط ارتباطاً وثيقاً بالتمثيل الزمني لجملة "قد". ثانياً من الملاحظ أن القراءة الكلية للأداة "قد" تفيد المضمون الحقيقي لجملة الوصف، وفي هذه الورقة سيتم تقديم حل منطقي بنائي من شأنه تفسير هاتين المسألتين ضمن الاشتقاق التركيبي المعنوي.

الكلمات المفتاحية: دلالة المعرفة، القوة العددية المعجمية، التضمين الحقيقي.

Endnotes

- ¹ building on insights from Barcan (1946, 1947), Carnap (1946) and Lewis (1968).
- ² As universal/ existential quantifiers, necessity and possibility modals have a similar pattern of logical entailment and equivalence to that of universal and existential nominal quantificational DPs:
- | | |
|---|---|
| <p>(1) a. Every student is home \Rightarrow Some student home.
 home.
 b. Some student is home \equiv It is not the case that every student is not home.
 that it must be
 c. Every student is home \equiv It is not the case that some student is not home.
 that it may be</p> | <p>(2) a. John must be home \Rightarrow John may be home.
 home.
 b. John may be home \equiv It is not the case that the case that John is not home.
 the case that John is not home.
 b. John must be home \equiv It is not the case that the case that John is not home.
 the case that John is not home.
 (Hacquard 2011: 1486)</p> |
|---|---|
- ³ The postulation of an ordering source prevents the inference from a modalized structure (e.g. The key must be available) into the corresponding non-modalized structure (The key is available) by restricting the set of accessible worlds that is quantified over to those worlds which are in best conformity to some relevant stereotypical ideal. Since the actual world w_0 does not need to be among this set of best accessible worlds, the inference is blocked.
- ⁴ Bahloul (2008) presented supporting evidence of the view that QAD is inherently a modal (see footnote 14 below). Although Bahloul (2008) focuses on the syntax-semantics of modal QAD in the context of the perfect tense, he observed that QAD interacts with the imperfect to express the possibility force of quantification of its modality meaning. If modal logic is mainly concerned with the logic of necessities and possibilities, the phenomenon of QAD-modality should not only be viewed from the angle of its interaction with the perfect (= contra to Bahloul 2008: 77, and Fassi Fahri 2012: p.8) , but from a broader perspective where modal QAD interacts with temporal-aspectual properties of the preajacent (perfect vs. imperfect) in such a way that the possibility force of quantification is systematically correlates with the imperfect and the necessity force with the perfect. This lexically-determined quantification force of QAD went overlooked in representative literature on QAD-modality which is based on the traditional view that assigns no role for time in the interpretation of modal QAD and hence it is incompatible with the problem of lexically, time-governed quantification force of QAD modal. In section one, we will review the previous analyses of QAD. For more information on Arabic, See Ababneh et al. (2017), Fukara (2022) Zyoud and Zyoud (2022) and Abu Helal (2021a,b) and Abu Helal (2022) for more information.
- ⁵ Any theory of modality should address the question of modal force which represents a point of crosslinguistic variation (Matthewson 2016)
- ⁶ It has been observed that quantification over nominal (e.g., individuals) and non-nominal domains (e.g., temporal or modal) exhibit logical similarities that unify their domains under an ontological symmetry program (Szabolcsi, 2010, Schlenker, 2006). One systematic correspondence between nominal and non-nominal quantification is that they both make use of (extra) linguistic devices that indicate duality of strength (i.e., existential vs. universal force). See Schlenker (2006) for a characterization of such an ontological symmetry program in the domain of individuals, times and

possible worlds. Modal QAD has a quantification force whose duality of strength is constrained by the temporal-aspectual composition of QAD's prejacent.

- ⁷ See Gosselin (2013) for a similar argument that encompasses similar facts in French that necessitate rejecting the time-modality distinction and returning the view that the two categories are major components of every sentence.
- ⁸ See Bhatt (1999), Hacquard (2009) and Mari (2016) for different solutions of the same puzzle in which ability modals in Hindi and French trigger actuality entailment when they occur with the perfective.
- ⁹ With one crucial differences between qad modality in Standard Arabic and root modals in French and Hindi: *qad* is an epistemic, speaker-oriented and it should be evaluated relative to the speech-time (denoting expectation as suggested by Al-Zamakhshari (11th century)). It has been claimed that only root modals trigger actuality entailment (Hacquard, 2009; Mari, 2016). As our data show, modal *qad*, which is not root modal, may implicate the realization of its prejacent.
- ¹⁰ See Bahloul (2008: Ch 5) for a general overview of these approaches. It is worth mentioning that the classical use of QAD is lexically ambiguous between a nominal and verbal use: while the Kufa School of grammar analyzes QAD as a noun which has the meaning of sufficiency, the Basra school of grammar takes it as a verb that means something like "suffice". In this paper, I analyze the verbal particle QAD which denotes the modality meaning of expectation (Ibn Hishaam 12th century).
- ¹¹ when modifying perfect or past tensed propositions
- ¹² The aspectual meaning of QAD holds true when pre-modifying a perfect-tensed proposition.
- ¹³ which is marked for perfect tense
- ¹⁴ See Chafe & Nichols (1986) for more information on the linguistic term "evidentiality" and its cross-linguistic forms.
- ¹⁵ Bahloul (2008) presented an argument based on the syntactic and semantic-pragmatic distribution of *qad* that supports the invariant modality meaning of QAD. Bahloul (2008) observed that there is some type of complementary distribution between the use of QAD and the assertive particle *ʔinna* in sentence initial contexts as exemplified in (i). He also observed that both assertion-denoting particles may co-occur within the sentence and there is a kind of complementary distribution between *qad* and assertive *la* in the presence of *ʔinna*. This pattern seems to suggest that QAD is inherently a modal object with an assertive-modality meaning.

- (i) a. wa Ø sarrafi-a waziiru al-maaliyyati . . . b. wa *qad* sarrafiya Franz
 Anderson . .
 and announce-Pf minister the-finance and QAD announce-Pf
 Franz Anderson
 "The minister of finance announced . . ." "Franz Anderson affirmed . . ."
- (ii) a. wa Ø maa yatahaddadu at-tayyaara al-ʔislaamli .
 and what threaten.lmp the-movement the-islamic
 "What threatens the Islamic movement . . ."
- b. wa *ʔinna* maa tuqbilu ʕalay-hi al-bilaadu . . .

and ?INNA what faces on-it the-country
 “What will indeed face the country . . .”

(Bahloul, 2008: 88)

(iii) a. fa- ?inna kasba-hu(. . .) qadtaxallafa ?an
 and- indeed earning-its(. . .) QAD fail.Pf about
 muwaazaati ?aalika al-mustawaa
 equivalence that that the-level
 wa muwaafaati faa?aati-hi . . .
 and fulfillment needs-its

“Its earnings have really dropped and could not keep up with that standard in order to fulfill its needs . . .”
 (it _ the Islamic movement)

b. ?inna haa?aa al-?istirsala fii at-tan*iiri la-yafmilu
 ?INNA this the-continuation in the-envisionment LA-carries
 fii tayaati-hi ?istii?aaban li- l mu?tayaati
 in inside-its understanding of-the-facts

“This ease of envisioning DOES reveal an understanding of the facts . . .”

(Bahloul 2008, 88- 89)

¹⁶ This precedence relation is not a before-after relation in temporal sense. It is a precedence relation < that orders indices with respect to which indices are taken to be more similar or alike to what the speaker thinks the actual world is (= speaker’s expectation) (Lewis,1979). The set of indices that occupy the uttermost left side of the relation < is the most minimal, optimal with respect to this relation.

¹⁷ The first index j is the evaluation time [SP₁-SP₂] and the second k is the reference time.

¹⁸ This paper adopts the pronominal analysis of tense as originated in Partee (1973). An alternative semantics analyzes tenses as (un)restricted quantifiers (Prior 1967; von Stechow, 2009). The pronominal analysis is motivated by a well-known empirical puzzle that is typically illustrated with the temporal interpretation of (i):

(i) I didn’t turn off the stove

The intuitive reading of (i) is that it is not the case that the speaker turned off the stove at some specific definite time. The quantificational analysis is problematic for (i). It yields one of two unattested readings: (a) With the negation taking scope over the existential quantifier, it generates the unattested reading that it is not the case that the speaker has turned off the stove (= maybe false) or (b) with the quantifier taking scope over the negation, it means that at some past time, the speaker did not turn off the stove (= trivially true at natural settings). This paper assumes the pronominal approach.

¹⁹ On the assumption that the perfective satisfies a boundedness condition (Mari, 2016).

²⁰ The ban on maximization follows from a generalization in which maximization is impossible in necessarily open monotone properties (c.f., Fox & Hackl, 2006 for an investigation of this generalization into other empirical phenomena including scalar implicatures, only-operator, definite descriptions and degree questions).

²¹ A deterministic view of the universe holds that the state of affairs at i is determined by preceding facts or laws of nature (Lewis, 1979). Under this view, two indices i, i' are either always alike or never alike. The non-deterministic allows the sharing of two indices i, i' the same evidential history with the future being a point of difference between i and i' as an unsettled and unpredictable domain. This paper assumes the latter view.

²² See Sibawayh (8th century, reviewed and edited in Haroon (1977: 307)), al-muradi (14th century reviewed in qubawa and Fadil (1992:255)); al-Galaayini (1993: 266); Ibn Hisham (14th century *a*, reviewed and edited in I-qouji(1997: 142-148)).Ibn Hisham (14thcentury*b*, reviewed and edited inal-xatiib (2001: 231-532)).

²³ See Faller (2002) on Cuzco Quechua.

²⁴ Notice that *qad* can be embedded under certain circumstances: it can mainly serve as an argument of verbs like *say* 'qala' as exemplified in (i).

(i) *Zayd-un qala ann-hu qad taḥardʒ-a*
 Zayd-NOM say.PST.3SL.M that-3SL.M QAD graduate.PST.3SL.M
 ' Zayd said that he certainly graduated.'

Krifka (2014) argued that speech acts like QAD, which can be embedded under verbs like *tell*, can be embedded under verbs like *tell*, are functions from world-time indices to world-time indices. In this way, such speech acts are assigned a semantic type to compose with operators like the verb *tell* (see Krifka (2014) for more details).

²⁵ Of course, we can rewrite the function in (34) as the following accessibility relation:

(i) $i' \text{ Acc } i =: \{ i' : i' \text{ is a time-world index in which all the historical evidence pieces obtained up to } i \}$

²⁶ A precedent for this idea is found in Rullmann et al. (2008) where the context-dependent variability of modals in St'a't'imcets is attributed to the kind of choice function restriction that can select a larger or smaller subset of accessible worlds: on the universal reading, the choice function is an identity function that selects the entire set of accessible worlds. On the existential reading, however, the choice function selects a proper subset of accessible worlds resulting in a weaker reading of modals.

²⁷ We view evidential histories in terms of reliability scale that is dense and left-linear with its degrees corresponding to evidence pieces that are ordered relative to an upward monotone property with a non-deterministic view of the universe.

²⁸ The structure $\langle I_{\text{atom}}, \oplus, \subseteq, p \rangle$ <corresponds to $\langle I_{\text{atom}}, \cup, \subseteq, p \rangle$ <> in set-theoretic terms.

²⁹ The ban on maximization follows from a generalization in which maximization is impossible in necessarily open monotone properties (c.f., Fox & Hackl, 2006 for an investigation of this generalization into other empirical phenomena including scalar implicatures, only-operator, definite descriptions and degree questions).

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