SM 2.G: Summary on non-linear relationships

This document summarizes the results of tests of non-linear relationships included in the reports that the meta-analysis was based on (but see notes on limitations at the end of the document).

Table 1: Summary of non-linear tests by functional form and diversity domain

Test	Hypothesized [a] #	Supported (partly / fully) #	Supported (partly / fully) %
Non-Linearity Total	26	23 / 17	88% / 65%
Functional form:			
U-Shaped	7	6 / 4	86 % / 57%
∩-Shaped	16	14 / 12	88% / 75%
Diminishing/Mixed	3	2-3	67% / 100%
Diversity domain [b]			
Cognitive [c]	10	8 / 5	80% / 50%
Demographic [d]	9	6 / 5	67% / 56%
Job-related	9	8 / 8	89% / 89%

[a] An additional 7 articles tested for non-linearity without including this into their hypotheses (or research questions). They are included into the study-level table below, but not into the summary tables. [b] Some articles considered more than one domain, so that the sum of domains exceeds the number of articles. Conversely, one article that only aggregated across domains is excluded here (Chen et al., 2015). [c] Excludes (Dahlan et al., 2021) who considered *perceived* cognitive diversity. [d] Excludes (Dayan et al., 2017) who consider perceived demographic diversity.

Table 2: Summary of non-linear tests by article

Diversity Domain	Refer-ence	Hypotheses	Variables	Findings	Shape		Explanations of non-linear relationship
					hypoth	found	
Cognitive	(Bao, 2020)	Not stated	IV1: knowledge diversity DV: research teams' publication performance	Relationship between knowledge diversity and performance consists of negative linear and positive quadratic term (so generally U-shaped, but unclear which part of the shape is considered)	-	∪ (implied)	Not discussed
	(Cheng et al., 2012)	H1b: There is an ∩-relationship between variance in team members' uncertainty avoidance and (early-stage) team performance. H2b: There is an ∩-relationship between variance in team members' relationship orientation and (later-stage) team performance.	IV1: diversity in uncertainty avoidance IV2: diversity in relationship orientation DV: team performance	H1b not supported. H2b supported.	∩ & ∩	n.s. & ∩	Intermediate degree of variance in relationship orientation suggests that both more task-related and more relationship-orientated team members exist and can complement each other – without becoming polarized. *NB: Used sample size of 33 to test moderated non-linear relationship.*
	(Hoogendoorn et al., 2017)	The relationship between the diversity of cognitive abilities in a start-up team and performance will be ∩-shaped.	IV: Cognitive ability (fluid intelligence) diversity DV: Student firm performance	∩-shaped relationship between ability dispersion and most indicators of performance.	∩	∩	Suggest that cognitive ability diversity promotes more efficient problem solving up to a point, beyond which communication difficulties undermine performance.
	(Lee et al., 2015)	H2a Field variety increases novelty but at a decreasing rate. H2b Task variety increases novelty but at a decreasing rate.	IV1: Field variety IV2: Task variety (perceived) DV: Novelty (in scientific work)	H2a not supported – only linear relationship was significant. H2b supported.	◜ & ◜	Linear & ◜	Expect that "as variety becomes very high, it becomes more difficult to ensure that members can communicate easily and convert specialized expertise into a novel final product" – and claim in conclusion that they have shown this relationship, despite the lack of significance.
	(Luan et al., 2015)	There is an inverted-U relationship between a team's	IV: Team educational	Found curvilinear relationship between	∩	∩	Build on discussion of literature that suggests that "excessive diversity can

	educational diversity and team creativity, moderated by teams' knowledge integration capability	diversity DV: Team creativity	team educational diversity and team creativity. Moderation suggested that the relationship essentially disappears for teams high in knowledge integration capability.			undermine a team's level of mutual understanding, which may cause the team's task-related information to go untapped. It may even lead to malign communication, interpersonal dislike, and thus declining team creativity (e.g. Gardner, Gino and Staats 2012; Shin and Zhou 2007; Smith et al. 1994; Tsui and O'Reilly 1989). Focus their discussion on the moderation effect, suggesting that knowledge integration capability can overcome challenges posed by high level of diversity (but do not discuss that their focus on inverted U-shapes implies that it also suppresses benefits at low levels of diversity)
(Narayan et al., 2020)	There is an inverted-U relationship between TMT ideological diversity and business model innovation intensity.	IV: TMT ideological diversity (support for Dem vs Rep) DV: BMI intensity (number of major business model innovations introduced)	Supported - strong nonlinear inverted U-effect (attenuated by team longevity)	∩	∩	Ideological diversity is beneficial as it veers team away from groupthink, but the positive effect of this is only up to a point. After this, too much ideological diversity can lead to polarization and conflict.
(Saá-Pérez et al., 2015)	There is an inverted U-shaped relationship between educational diversity of academic research teams and their performance (H3), as well as between their institutional diversity and their performance (H4).	IV1: Educational diversity (holding/not holding PhDs) IV2: Institutional diversity DV: Scientific performance (number of articles published)	H3 "partially" supported (not entirely clear why only partially, quadratic term is significant). H4 supported.	∩ & ∩	∩ & ∩	Explain accelerating decline of performance with increasing educational diversity with coordination and communication challenges. Similarly, increasing institutional diversity is proposed to initially promote exchange and widen knowledge, before "cultural conflict" outweighs these benefits. Suggest that these results may be more common in Western contexts where individuals focus on their own contribution than in in more collectivist Eastern contexts – so that more cross-cultural research is needed.

	(Vegt & Bunderson, 2005)	H5: Collective team identification moderates a curvilinear relationship between expertise diversity and team performance: There is a U-shaped relationship when collective team identification is low and an inverted U-shaped relationship when collective team identification is high.	IV: Expertise diversity Moderator: Collective team identification DV: Team performance	Supported – relationship U-shaped with low collective team identification, and inverse U shaped with high collective team identification (NB: Fig 1 legend shows the opposite, but consistent claims in text appear less likely to be a reporting mistake)	∪ / ∩ depending on moderator	∪ / ∩ depending on moderator	Suggest that under condition of high team identification, with increasing diversity team members are initially willing to integrate diverse perspectives to achieve better outcomes, until that leads to information overload and performance declines. Under conditions of low team identification, conversely, the negative effects of social categorization dominate initially, until "everybody is different", so that sub-grouping becomes less likely.
	(Yoo, 2020)	There is an inverted U-shaped relationship between expertise-domain diversity and project efficiency.	IV: expertise domain diversity DV: project efficiency	Not supported	∩	Linear	Not discussed – only highlight that research considering curvilinear relationships is rare and that result here conflicts with some previous research.
Demo-graphic	(Burris, 2001)	No nonlinear hypothesis stated	IV: number of females DV: team performance, output, outcome and operation measures	Quadratic analysis found U-shaped relationship between number of women and all DVs.	-	∪	Suggest that addition of women initially increases conflict, but that larger share of women then improve team processes because within-gender strategic alliances can be formed, and because the team has to start to rely on women.
	(Busse, 2018)	"General assumption" of a U-shaped relationship (hypotheses concern pairwise comparisons between levels, depending on team's longevity)	IV: Degree of gender-related heterogeneity (based on stereotypical values) DV: Team performance on marketing task	Results in trial 1 suggest linear negative relationship, while for trial 2, moderately heterogeneous teams perform worst (significance not reported, would depend on choice of correction for multiple comparisons)	∪ & ∪	linear / ∪	Discussion focused on superiority of highly heterogeneous groups over both other categories rather than the non-linearity.
	(Dahlan et al., 2021)	[Perceived] cognitive diversity (H1a) and demographic diversity (H1b) will have a curvilinear U-shaped effect on group performance.	IV1a: Perceived cognitive diversity IV1b: Demographic diversity (average of age, tenure and	H1a: quadratic term for cognitive diversity significant H2a: quadratic term for demographic diversity not significant	[∪ &] ∪	[∪ &] n. s.	Initially, diversity leads to the emergence of subgroups and intergroup conflict, while greater diversity then reduces the commonalities required for subgroup formation – so that conflict declines and the benefits of "diversity-related

		gender) DV: Group effectiveness				information advantages" can be realized
(Earley & Mosakowski, 2000)	In the long run, there will be a U-shaped relationship between nationality diversity and team performance.	IV: team heterogeneity DV: team effectiveness	Generally supported in two studies – homogenous and highly heterogeneous groups outperformed moderately heterogeneous teams	∪	∪	Argue that in moderately heterogeneous teams, subgroups will exist, and this categorization will sustain divisions – while highly heterogeneous groups can build a hybrid culture that creates a common identity, if they are given sufficient time (while homogenous groups would outperform them at the start).
(Ingersoll et al., 2017)	Article tests if theories "proposing an optimal level of diversity" are supported	IV: linguistic distance DV: Soccer team performance	Quadratic term not significant	∩	Linear	Do not consider non-linear relationships in discussion, instead assert strongly that there is a causal linear relationship.
(Kirkman et al., 2013)	The relationship between nationality diversity and the performance of organizational communities of practice is U-shaped.	IV: Nationality diversity DV:OCoP performance	Supported. Performance lowest at moderate levels of diversity, but higher at high than low levels (so they call it a J-shaped relationship)	∪	∪	Social categorization leads to "fractured cultures" and reduced performance and is highest at intermediate levels of diversity where teams are most vulnerable to "faultline and subgroup formation effects"
(Narayanan & Terris, 2020)	Not stated	DV – productivity (speed) IV 1 - count of disability categories IV 2 - disability Blau index	Non-linear relationships show opposite shape for the two diversity measures, so that intermediate number of categories but high or low dispersion is optimal.	-	∩ & ∪	Not extensively discussed but suggest that high levels of dispersion may reduce subgroup formation and thus conflict, and that having multiple disability categories present provides flexibility in task allocation (but do not address the negative association between disability categories and productivity over much of the range).
(Ray, 2016)	There is a curvilinear (inverted U-shaped) relationship between national diversity of TMTs and the longer-term post-acquisition performance.	IV: TMT national diversity DV: 3 performance indicators - BHAR, ROA, ROE	Supported. There is a positive influence of having foreigners in the TMT up until a turning point above the median of the sample.	∩	∩	Diversity initially increases understanding of cultural differences and cognition, but then this becomes "overshadowed" by ineffective communication.
(Seong & Hong, 2018)	H2. There will be an inverted U-shaped curvilinear relationship	IV: Age diversity	Supported	∩	∩	Expect that initially, increases in diversity will bring benefits by widening available skills, experiences

	between age diversity and group performance.	DV: Group performance				and connections – while higher levels of diversity trigger intergroup competition and conflict.
(Teruel & Segarra-Blasco, 2021)	No hypotheses stated	IV1: Gender diversity IV2: Occupational diversity DV: Number of patents	Diminishing returns for gender, inverted U curve for occupational diversity (though smooth estimation does not result in significance tests)	-	◜ / ∩	Not discussed.
(Tovar, 2019)	No hypotheses stated	IV1: Share of players from dominant nationality IV2: Nationality diversity (HI) DV: soccer team performance	Initially, increase in share of dominant nationality is associated with reduced performance – up to a turning point from where greater homogeneity benefits the team. No linear relationship between more common diversity indices and performance	-	∪	Suggest that benefits can come either from high diversity (when no subgroups can form and the team will create a shared understanding) or from a dominant (national) identity – but not when the two stand in tension at intermediate levels of diversity.
(Wise et al., 2022)	Not stated	IV: gender diversity (no non-linear tests reported for other diversity measures) DV: total capital raised by startup	Gender diversity (IV3) has positive linear and a negative quadratic relationship with the DV.	-	∩ (*implied*)	*Not discussed, as gender diversity only served as control variable*
(Wu & Konrad, 2022)	Team age diversity has an ∩-shaped relationship to perceived team effectiveness.	IV: Team age diversity DV: Perceived team effectiveness	Weakly supported - quadratic age diversity term 'approached significance'	∩	∩	Highlight that their data only captures the "increasing left-hand side" of the ∩ but suggest that other studies indicate that there is a true turning point beyond their range of age diversity. Consequently, suggest that contradictory results in studies may be caused by range restrictions in diversity within samples.

Job-related	(Binacci et al., 2015)	There will be a U-shaped relationship between NFT tenure diversity and family firm performance.	IV: Tenure diversity DV: Return on assets (ROA)	Supported, with a turning point above the mean of the sample	∪	∪	Expect that initially, diversity increases competition and conflict, while at higher levels of diversity, competition decreases as team members no longer compete for the same positions, and are able to benefit from each other.
	(Chi et al., 2009)	The relationship between organizational tenure diversity and team innovation follows an ∩-shape.	IV: organizational tenure diversity DV: Team innovation	H1 supported – significant quadratic term for tenure diversity Quadratic terms for education and industry experience diversity not significant (exploratory analyses)	∩	∩	At very high levels of tenure diversity, teams may lack a common frame of reference and conflicts may arise. At lower levels, greater diversity will enable teams to draw on more diverse networks, perspectives and experiences, which can enhance problem-solving.
	(Dayan et al., 2017)	H1: "The relationship between functional diversity and new product creativity is non-linear (∩-shaped)" H2: "The relationship between [perceived] social category diversity and new product creativity is non-linear (∩-shaped)"	IV1: Functional diversity - number of functional areas represented in the team [IV2: perceived demographic diversity] DV: New product creativity	H1 supported - reverse u-shaped relationship between functional diversity and new product creativity H2 rejected - found U-shaped relationship between perceived demographic diversity and new product creativity [excluded from summary here, as perceived measures are out of scope]	∩ [& ∩]	∩ [& ∪]	Relationship for functional diversity is positive up to a certain point as breadth of knowledge and experience increases, but after a certain point it becomes negative due to problems such as ineffective communication and poor teamwork Speculate that U-shape for demographic diversity might be "because [at high levels] team members will be more evenly dispersed demographically, and in-group out-group identities will be reduced"
	(Hoisl et al., 2016)	In hypercompetitive environments, R&D teams show a ∩-shaped relationship between experience diversity and performance.	IV: Experience diversity DV: R&D Team performance	H1 supported – with inflection point close to, but below the mean. Follow-up tests confirmed that the slope below the inflection point is significant and positive, above the inflection point significant and negative	∩	∩	Benefits of experience diversity come with communication and coordination costs, particularly in high-pressure competitive environment (here of F1 racing). Suggest that coordination costs increase exponentially (as each new field added interfaces with all teams already there), so that they come to outweigh benefits at a critical point.

(Tagliazucchi et al., 2021)	There is a U-shaped relationship between Founding Teams' composition variety and the growth performance of university spin-offs.	IV: Variety in academic and non-academic background of founding team DV: sales growth	Supported, with lowest performance at intermediate diversity level	∪	∪	Suggest that homogenous teams can be more effective, while highly heterogeneous teams can deliver innovation and creativity – while at intermediate levels, "team members do not seem to be motivated to integrate diverse specialized knowledge" as the differences are too modest to appear valuable.
(Tekleab et al., 2016)	No hypothesis concerning team performance.	IV: Team functional diversity DV: Team performance	No significant linear or quadratic relationship with team performance (though moderated curvilinear relationship with cohesion)	-	n. s.	Suggest that increasing function diversity would lead to more subgroup formations, and the effect will initially be negative. But after a certain level of diversity, subgroups will be able to form less as there will be fewer communalities among team members
(Vicentini & Boccardelli, 2016)	An ∩-shaped relationship exists between team members' past industry career diversity across project-based industries and current project performance.	IV: Diversity of career patterns - prior experiences across project-based industries DV: Project performance	Supported - ∩-shaped relationship, with turning point above the sample mean	∩	∩	Highlight that their results primarily support the upwards part of the inverted U. Suggest that after the initial creative benefits from diversity, an excess in diversity may lead to reduced performance due to a lack of industry specialization.
(Yi et al., 2018)	H1: TMT tenure diversity variety will have a positive effect on team performance, but at a diminishing marginal rate. H2: TMT tenure diversity separation will have a negative effect on team performance, at an increasing marginal rate.	IV1: Tenure Variety IV2: Tenure Separation - "sense of distance or separation team members feel toward each other due to different organizational tenures" (26) DV: top management team (TMT) performance	H1 supported H2: supported	◜ & ◝	◜ & ◝	Suggest that TMT tenure diversity variety affects mainly the information processing process within the team and thus has a positive effect although at a declining marginal rate as coordination costs increase – they explicitly claim that at a higher level than those observed, coordination costs would outweigh benefits for a negative net effect. TMT tenure diversity separation is proposed to affect mainly the social categorization process within the team and thus mostly has a negative effect – though they do not make it explicit why this relationship is becoming stronger

Demo-graphic [Cognitive]							
Cognitive Demo-graphic Job-related	(O'Bannon, 1998)	There will be a curvilinear relationship between all TMT diversity measures and firm performance, with performance highest at intermediate levels.	IV: Age, tenure, educational and functional diversity heterogeneity DV: Firm performance	No significant curvilinear effects for age, tenure and functional diversity. "Weak" (i.e. $p < .1$) evidence for U-shaped relationship between educational diversity and performance.	5 x ∪	4 x n.s. & 1 x ∪	Propose compromise solution that unifies management argument that diversity provides a resource with social psychology argument that it promotes conflict – so that an intermediate level of diversity can combine cohesion with diverse cognitive resources. However, fail to find "a single instance" that supports this model, but instead propose interaction between different types of diversity.
Cognitive Job-related	(Ren et al., 2016)	H1: Inverted-U relationship between tenure disparity and group productivity. H3: Inverted-U between interest variety and group productivity.	DV: Group productivity IV 1: Tenure Disparity IV 2: Interest variety	H1 supported - curvilinear relationship present. H3 tested differently, non-linearity found. Quadratic term excluded due to multicollinearity, instead categorized to show that increase from low to medium variety was more associated with productivity than increase from medium to high variety.	∩ & ∩	∩ & ◜	Suggest that initially, tenure disparity reduces withdrawal, while higher levels of disparity increase withdrawal, and thus reduce productivity. For interest variety, suggest that initial increases mostly increase the breadth of available information, while later increases are likely to cause disagreement, so that group members may become overwhelmed and fail to integrate information effectively.
Composite	(Chen et al., 2015)	The relationship between team diversity and new product performance is inverse U-shaped, with the slope being positive at low levels of team diversity and negative at high levels of team diversity.	IV: Team diversity (demographic differences and functional diversities) DV: new product performance using survey measures	Shape supported, though the explicit claim that relationship is positive in one range and negative in another is not tested.	∩	∩	Results suggest that suggests an "optimal level of team diversity exists." Positive relationship explained by informational resources, specifically the "formation of the collective knowledge structure providing the benefits of the broader perspectives, generates innovative ideas, and evaluates the possible solutions to the problem." The negative relationship is explained by social identity theory, specifically

	communication difficulties and conflict.

Limitations of this overview:

- This overview only includes papers that were included in the meta-analysis, for which they had to report *linear* relationships (typically correlations). This led to the exclusion of some papers that *only* reported non-linear relationships (e.g., Slomka-Golebiowska et al., 2023).
- This overview only includes reports published in English. Some of the reports published in other languages that we included also contained test of non-linear relationships (e.g., Lin, 2019; Ping, 2015), yet we did not trust the machine translations sufficiently to include them here.
- The focus of our coding was on linear relations, so that we may have missed non-linear relations that were presented as robustness checks. In addition, we generally did not review appendices or supplementary materials.
- Studies that only claimed that they had checked for non-linearity, without reporting statistical results, were also excluded here (i.e. Krishnan & Park, 2005; Quintana-García et al., 2016; Vandekerkhof et al., 2019)

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